U. S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
National Marine Fisheries Service
SOUTHWEST FISHERIES CENTER
La Jolla, California 92038

AERIAL SURVEY TRIP REPORT*

AIRCRAFT: P2V-7 (SP-2H) Neptune anti-submarine patrol bomber on loan from the Department of Defense and operated by the Office of Aircraft Services, Department of the Interior.

PBY-6A Catalina amphibian Navy patrol bomber owned and operated by the Cousteau Society.

TRIP PERIOD: Because of mechanical and other problems, the survey was disrupted on three occasions resulting in a prolonged four-phase operation covering about 6 months. The time periods were:

Phase I, P2V: January 22 to February 16, 1977
Phase II, P2V: March 19 to April 7, 1977
Phase III, PBY: April 28 to May 18, 1977
Phase IV, PBY: June 10 to June 20, 1977

ITINERARY: The flight schedules for the various phases follow.

Phase 1, P2V Neptune (Office of Aircraft Services)

Flight No. & Mode	Date	Depart (Time)	Arrive (Time)
1 Ferry-shakedown	Jan. 22	San Diego, California (0930)	Mazatlan, Mexico (1600)
2 Survey	Jan. 23	Mazatlan, Mexico (0645)	Mazatlan, Mexico (1930)
3 Survey	Jan. 25	Mazatlan, Mexico (0230)	Puerto Vallarta, Mexico (1530)
4 Survey	Jan. 26	Puerto Vallarta, Mexico (0700)	Puerto Vallarta, Mexico (1930)
5 Survey	Jan. 31	Puerto Vallarta, Mexico (0800)	Manzanillo, Mexico (2000)
6 Survey	Feb. 2	Manzanillo, Mexico (0800)	Acapulco, Mexico (2100)

*The nature of aerial surveys make it necessary to deviate from the standard format of SWFC cruise reports.

Phase I, P2V Neptune (Office of Aircraft Services) (continued)

Flight No. & Mode	Date	Depart (Time)	Arrive (Time)
7 Survey	Feb. 4	Acapulco, Mexico (0600)	Acapulco, Mexico (1930)
8 Survey	Feb. 6	Acapulco, Mexico (0730)	Acapulco, Mexico (2030)
9 Survey	Feb. 8	Acapulco, Mexico (0530)	Acapulco, Mexico (1750)
10 Survey	Feb. 10	Acapulco, Mexico (0600)	Acapulco, Mexico (2200)
-- Ferry	Feb. 11	Acapulco, Mexico (1330)	Guatemala City, Guatemala (1730)
11 Survey	Feb. 13	Guatemala City, Guatemala (0625)	Guatemala City, Guatemala (1730)
-- Ferry	Feb. 16	Guatemala City, Guatemala (0800)	San Diego, California (2100)

(The scientific party returned to San Diego, California via commercial airline on February 15, 1977.)

Phase II, P2V Neptune (Office of Aircraft Services)

Flight No. & Mode	Date	Depart (Time)	Arrive (Time)
-- Ferry	Mar. 19	San Diego, California (2100)	Guatemala City, Guatemala (3/20,0930)
12 Survey	Mar. 22	Guatemala City, Guatemala (0645)	Guatemala City, Guatemala (1845)
13 Survey	Mar. 24	Guatemala City, Guatemala (0650)	Guayaquil, Ecuador (1925)
14 (Aborted)	Mar. 26	Guayaquil, Ecuador (0800)	Guayaquil, Ecuador (0930)
14 Survey	Mar. 27	Guayaquil, Ecuador (1030)	Guayaquil, Ecuador (2050)
-- Ferry	Mar. 28	Guayaquil, Ecuador (1315)	Lima, Peru (1640)
15 Survey	Mar. 29	Lima, Peru (0650)	Lima, Peru (1930)
16 Survey	Mar. 31	Lima, Peru (0650)	Lima, Peru (1910)
17 Survey	Apr. 2	Lima, Peru (0750)	San Jose, Costa Rica (1830)
18 Survey	Apr. 4	San Jose, Costa Rica (0630)	Howard AFB, CZ Panama (1600)

(All personnel returned to Los Angeles, California, via commercial airline on April 7.)

Phase III, PBY Catalina (Cousteau Society)

Flight No. & Mode	Date	Depart (Time)	Arrive (Time)
19 Survey	Apr. 28	San Jose, Costa Rica (0615)	San Jose, Costa Rica (1725)
20 Survey	Apr. 30	San Jose, Costa Rica (0815)	Acapulco, Mexico (1720)
21 (Aborted)	May 2	Acapulco, Mexico (0600)	Acapulco, Mexico (0630)
-- Ferry	May 3	Acapulco, Mexico (1630)	San Jose, Costa Rica (5/4, 0030)
-- Ferry	May 9	San Jose, Costa Rica (0830)	Acapulco, Mexico (1730)
21 Survey	May 10	Acapulco, Mexico (0448)	Acapulco, Mexico (1750)
22 Survey	May 11	Acapulco, Mexico (0705)	Acapulco, Mexico (2035)
23 Survey	May 13	Acapulco, Mexico (0710)	Puerto Vallarta, Mexico (2325)
24 Survey	May 15	Puerto Vallarta, Mexico (0615)	Puerto Vallarta, Mexico (2130)
25 Survey	May 16	Puerto Vallarta, Mexico (1440)	La Paz, Mexico (1845)
26 Survey	May 17	La Paz, Mexico (0300)	La Paz, Mexico (1625)
27 Special Study & Ferry	May 18	La Paz, Mexico (0805)	San Diego, California (1700)

(The scientific party departed Los Angeles, California, for San Jose, Costa Rica via commercial airline on April 21.)

Phase IV, PBY Catalina (Cousteau Society)

Flight No. & Mode	Date	Depart (Time)	Arrive (Time)
-- Ferry	Jun. 6	Long Beach, California (1100)	Oakland, California (1400)
-- Ferry	Jun. 8	Oakland, California (0500)	Honolulu, Hawaii (2300)
-- Ferry	Jun. 11	Honolulu, Hawaii (1100)	Hilo, Hawaii (1330)
28 Survey	Jun. 12	Hilo, Hawaii (0710)	Hilo, Hawaii (2100)
29 Survey	Jun. 14	Hilo, Hawaii (0520)	Hilo, Hawaii (2130)
30 Survey	Jun. 16	Hilo, Hawaii (0511)	Hilo, Hawaii (2030)
31 Survey	Jun. 19	Hilo, Hawaii (0440)	Hilo, Hawaii (1850)
-- Ferry	Jun. 21	Hilo, Hawaii (1040)	Honolulu, Hawaii (1300)

(The scientific party traveled from San Diego, California to Hilo, Hawaii via commercial carrier on June 10.) (At the termination of the flights during the third week in July, ferry flights were made from Honolulu to Wake Island, from there to Adak, and then on to Anchorage, Alaska, on July 22.)

PERSONNEL:

There were few changes in scientific party personnel throughout the survey. Eric Barham, Joseph Powers, Charles Oliver, and Richard Charter were members on all phases. Steven Leatherwood took part on Phase I while William Walker made the last three phases. Lt. Jackson worked the P2V flights which demanded one more observer than the PBY.

Regarding changes of flight crew members, Stuart Peterson took Thomas Belleau's place on Phase II of the P2V flights and Richard Probert replaced Philipe Cousteau for the Hawaiian phase of the operation. Guy Jouas did not accompany the PBY on the Phase IV flights. Personnel for the various phases are listed below.

Phase I.

Crew: Pilot, Thomas Belleau
Pilot, Lucien Caulkett
Flight Engineer: Daniel McGehee
Scientific Party: Eric Barham, NMFS
Joseph Powers, NMFS
Charles Oliver, NMFS
Richard Charter, NMFS
Lt. Terrence Jackson, NOAA Corps
Steven Leatherwood, Naval Ocean Systems Center

Phase II.

Crew: Chief Pilot, Lucien Caulkett
Co-pilot, Stuart Peterson
Flight Engineer, Daniel McGehee
Scientific Party: Eric Barham, NMFS
Joseph Powers, NMFS
Charles Oliver, NMFS
Richard Charter, NMFS
William Walker, NMFS
Lt. Terrence Jackson, NOAA Corps

Phase III.

Crew: Chief Pilot, Philipe Cousteau
Co-pilot, Michael Sullivan
Flight Engineer, Guy Jouas
Scientific Party: Eric Barham, NMFS
Joseph Powers, NMFS
Charles Oliver, NMFS
Richard Charter, NMFS
William Walker, NMFS

Phase IV.

Crew: Chief Pilot, Richard Probert
Co-pilot, Michael Sullivan
Scientific Party: Eric Barham, NMFS
Joseph Powers, NMFS
Charles Oliver, NMFS
Richard Charter, NMFS
William Walker, NMFS

OBJECTIVES AND TASKS:

Using slow, low flying, long-range aircraft with configurations permitting unobstructed views to the front and to both sides of the plane, traverse ocean areas as far seaward as possible from land bases consistent with safety practices.

During these flights, search for porpoise schools using methods compatible with line transect theory and estimate their perpendicular distances from the track line.

When safety of the aircraft permits, leave the track line and circle schools to: (a) estimate the numbers of individuals in schools; (b) attempt to identify the individuals as to species; and (c) measure when possible the perpendicular distance of the school from the track line with the aid of a navigational system.

When conditions permit, obtain vertical 9-inch photographs of porpoise schools for enumeration of individuals and study of school structure.

When conditions permit, take 35 mm photographs of porpoises for possible species identification.

Record infrared radiometer sea surface temperature measurements for possible correlation with porpoise distribution.

Make a special flight in the Gulf of California to study the variance of observer's school size estimates; attempt to photograph the estimated schools with a 9-inch and a motion picture camera.

Schedule foreign scientists to observe the inflight operations.

On a not-to-interfere basis, make observations of other marine mammals, fishes, and birds.

AIRCRAFT:

Because of mechanical failures, it was necessary to switch the operation from one type of plane, a P2V-7 (SP2H) Neptune to another, a PBY-6A Catalina. While the planes are configured differently and have different operating capabilities, they also share similar characteristics that permitted a relatively smooth transition between Phases I-II and III-IV and continuation of the basic survey plan.

Both aircraft have observation stations in the nose of the plane that permit scrutiny of the water approaching and passing directly under the plane, and both have excellent lateral observational stations in the rear of the plane allowing an unobstructed scan from about one-tenth of a mile from the track line outward to the limits permitted by the aircraft's altitude and the environmental conditions. Both aircraft are also unpressurized, and windows and ports can be opened for photography and instrument sensors.

To contrast basic operational differences, the P2V, powered by two large radial engines and two jets for high demand power settings, has greater range capability mainly because of its faster cruising speed--145-200 knots depending on the prevailing winds. (Figures 1 and 2, showing the track lines of Phases I-II and III-IV, clearly indicate this difference.) Contingent on the time spent off the track line to circle porpoise schools and deadheading distances to and from the track line to the base of operations, the Neptune can cover a distance of about 850-1000 nautical miles (nm) offshore with a 2-hour safety reserve. Under the same constraints, the PBY, with its two smaller radial engines, is limited to about 650-800 nm. In the Neptune's favor, this plane has greater weight-carrying capacity, and unlike the Catalina, it can also carry a greater scientific payload without degradation of performance. The PBY, on the other hand, with its slower cruising

speed (80-130 knots depending on prevailing winds) and larger wing area, proved to be far superior for circling schools for species identification, numbers estimation, and photography. The Catalina also has better characteristics for viewing and was much better in terms of living amenities for the crew and scientific party.

FLIGHT PROCEDURES:

Depending on wind conditions, cruising speed varied during search operations in the P2V from 145-200 knots. Under similar conditions, the PBY cruised between 80-130 knots. On both aircraft, altitude while in search mode was varied according to sea state. At Beaufort Force 3 or lower, the aircraft was flown at 1500 feet. If the sea state rose to a Force 4, the plane was taken down to 1200 feet. At higher sea states than Force 4, the aircraft descended to 1000 feet. Occasionally, the altitude was adjusted to avoid decks of clouds, but the plane's course was not changed to avoid squalls.

The original plan of operation called for switching the direction of search from offshore to onshore on alternating flights. This necessitated critically-timed early morning departures on every other flight in order to deadhead to the end of the track line, thus allowing adequate light for searching on the return course. This scheduling was discontinued after Flight 4 due to difficulties in getting flight clearances and landing strip lighting service for night takeoffs. Beginning with Flight 5, we also began to search on both the offshore and onshore tracks, resulting in a marked increase of search time on this and subsequent flights. Search operations were conducted only when the available light was considered adequate, roughly between 0730 and 1730 hours local time.

Total times of flights differed depending on the courses and destinations, but most flights on the P2V were from 10-14 hours duration, while PBY flights generally were longer, covering 12-16 hour periods.

Regarding temporal spacing of the flights, it was originally planned to fly two days out of three. However, the physical demands of the flights on the crew, the long times needed to refuel and maintain the aircraft, and the necessity of daylight operations at some aerodromes soon forced a shift to a day-on/day-off operation. Problems that caused time delays are discussed in a later section of this report.

INSTRUMENTS AND EQUIPMENT:

Radiation Thermometer

Sea surface temperature was sensed with a Barnes PRT-5 Precision Radiation Thermometer equipped with a special narrow aperture band-pass filter (10.5-12.5 microns). The sensor transducer was directed through a small hatch in the waist floor of the P2V. The thermometer output was fed to a Varian G-14 strip chart recorder run at 1-inch-per-minute speed. This instrument was not used in the PBY.

Navigation System and Clinometer

A Global Navigation System (GNS-500A) was used to measure the perpendicular distances of porpoise schools from the track line, positions, and Greenwich Mean Times.

On occasion, a hand-held optical reading clinometer (Suunto-PM-5/360 PC) was also employed to compute distances to porpoise schools. If these schools, however, were within about one-half mile of the track line, time was usually not available to utilize these instruments, and visual estimates were relied upon. Several checks using smoke signals as targets indicated that visual estimates up to half-mile ranges are usually accurate to one-tenth of a mile which was also the accuracy of the GNS.

Cameras

Two fixed vertically-directed cameras were used to photograph porpoise schools and sea state. Primary reliance on photographing porpoise schools was placed on a 9-inch format aerial reconnaissance and mapping system. The main components of this system are World War II era equipment refurbished by Alan Gordon Enterprises. The camera body was a K-17C fitted with a 6-inch, f/6.3 lens covered by a minus blue anti-vignetting filter. A Model A-9B magazine capable of holding 490 exposures and cycling at a rate of 1 1/4 seconds was coupled to the camera body. An intervolometer (Type B-3B) automatically tripped the shutter and advanced the film at about 2-second intervals. The camera was suspended in a Type A-11-A shock-absorbing and leveling ring that was mounted over a large bottom hatch located just in front of the port observer's station in the waist of the P2V. A nearby venturi tube provided vacuum for the film magazine.

The same system was used in the PBY. The camera mount was installed over the "rear gunner's" hatch in the plane's tail stock. Quick-release knobs allowed rapid removal or jettisoning in case of an emergency water landing.

The film used was 200-foot rolls (about 250 exposures) of Kodak Ektachrome EF Aerographic SO-397. This special order film had proved best in preliminary tests in photographing porpoises.* During Phase I, an effort was made to keep the loaded magazine in a large portable icebox. After one magazine was flooded with water, this practice was discontinued.

A Hasselblad 500C fitted with a wide angle 50 mm lens and a prism view-finder was used as a back-up camera for porpoise school pictures and to photograph sea state conditions. This camera was bracket-mounted on the lower bulkhead in the waist and shot out of the same bottom hatch that accomodated the sensor. Kodak High Speed Ektachrome film was used. Use of the Hasselbald was discontinued in the PBY.

To obliquely photograph porpoise for species identification and verification, a hand-held, electrically-driven 35 mm camera (Nikon Nikkomat ELW) equipped with a 500 mm catadioptric telephoto lens was shot from the waist windows. Tri-X black and white film rated at ASA 1600 was used in this camera.

Cine photography of porpoise schools and coverage of the general operation was done with a Canon Scopic 16 mm motion picture camera equipped with an f/1.8 zoom lens (12.5-75mm) and automatic f/stop. Kodak Ektachrome 7256 MS film was generally used, but some Ektachrome 7241 EF was also exposed under poor light conditions. Most inflight film was shot at 33 frames per second and when possible through an open window. A gyro-stabilizer was frequently used.

Binoculars

Two types of binoculars were used to inspect targets of interest noted by eye and to identify marine mammals. (Swift Admiral Mark I, Model No. 751 10 X 50; Carl Zeiss 15 X 60).

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*Wittmann, F. P. and J. Benigno, 1976 Test Report: "Porpoise Film Selection Test." NMFS, Southeast Fisheries Center, Fisheries Engineering Laboratory, 25 pp.

Frequently, the 15-power Zeiss glass was used in conjunction with Ken-Lab Gyro stabilizers Model KS-4. A larger model KS-6 was generally used with the motion picture camera.

Smoke Flares and Dye Markers

Mark-25 smoke flares that ignite on contact with the sea surface and produce a copious column of dark smoke for about 15 minutes were used as an aid in relocating schools of porpoise. A hundred of these devices were obtained from the Naval Weapons Supply Center, Seal Beach, California. At the sudden termination of Phase II, about 40 flares remained. Because they are classified as an armament, it is difficult to ship them on commercial carriers, and they were left with the plane in Panama.

Small floating dye bombs were also used from both aircraft to "mark" porpoise schools. These were made according to the following formula: one tablespoon of eosin dye mixed with equal amounts of beach sand (for weight) and 2 or 3 pieces of styrofoam packing material (for buoyancy) were folded in two sheets of laboratory tissue paper and secured with rubber bands. Generally, two dye markers were thrown to aid as a direction indicator.

DUTY STATIONS:

In the P2V a 6-station system was used. (1) A "bow" observer sat on a bench seat up front in the plexiglass nose. His major responsibility was to guard the path directly on the plane's track and to each side for about one-tenth of a mile. (2) A recorder sat directly behind the bow observer with the GNS readout mounted on the overhead within his reach. His duties were to take transect data on a regular basis and to record data on sightings as they were transmitted from the observers via the intercom system. At times of sightings, he was also responsible for noting and recording coordinates and times and using the GNS cross track or position readouts to measure distances from the track line. (3) An instrument operator was stationed in the plane's waist near the temperature sensor and recorder and the fixed vertical cameras. His responsibilities were several: calibrate the radiometer system at about 20-minute intervals; annotate the temperature recordings with calibration readings, time marks, position coordinates, and notes on the existence of clouds, rain, or other events; operate the

Hasselblad camera to photograph porpoise schools and sea state; open the 9-inch camera hatch doors on command; and drop smoke flares or dye markers when directed. (4) and (5) Two lateral observers sat side-by-side adjacent to large windows in the rear waist of the plane. Their job was to search outboard from one-tenth of a mile to a subjective limit set by the environmental conditions of sea state and haze. (6) The last position was a non-duty station. This person could move freely around the plane, rest, or occupy himself as he wished.

The first five stations were in communication with each other and the flight deck via the intercom system. Personnel changed positions every 40 minutes as directed by the recorder in the sequence given above. Starting positions were assigned by drawing numbers before each flight.

Aboard the PBY, duty stations were reduced to five positions, but the recorder and observer's duties remained the same as for the P2V. (1) The bow observer lay on a mat looking out a window in the plane's nose. (2) The recorder sat at a table in the radio-navigation compartment directly behind the cockpit with the GNS readout mounted nearby. (3) The starboard observer sat on the mess table padded with cushions in the right waist blister. (4) The "rest" position--this person was on call at times of important sightings when the plane diverted from the trackline. At such times, his duties were to man the 9-inch camera, jettison dye markers on command, and make supplemental observations from the waist blisters. (5) The port observer sat on a small cushion-padded table mounted in the left blister. All stations and the pilots were in communication via headsets. Stations were again alternated on a 40-minute basis through the above sequence, and starting positions were established for each flight by a random draw.

GENERAL SEARCH PROCEDURES:

Observers relied mainly on the unaided eye for searching for porpoise schools. In a relatively calm sea, porpoise concentrations that are moving created a "scar" on the water that could be noted at considerable distances. Binoculars could then be used to scrutinize a scar for porpoise signs. At mid-distances (or at long distances through binoculars), movement and a show of white water were the most

conspicuous signs. Bird activity was also helpful, and if the animals were running or leaping, their bodies could be seen in the air at considerable distances. At short ranges, individual animals could be noted when laying quietly at the sea surface or submerged even under adverse weather conditions. The bow observer concentrated on the trackline and the adjacent water; the waist observers searched the water directly under them to the maximum distances to which they would normally expect to sight a porpoise school under the prevailing weather and light conditions.

The recorder maintained a "transect record" (Figure 3) of the flight number, leg number, date, altitude and ground speed of the aircraft during that period, and the code numbers of personnel at all duty stations. The environmental factors of sea state and sun position were also noted after consultation with the observers. A new transect record (or leg) was started at the 40-minute change of observers, when the aircraft made a major course shift, and when environmental conditions underwent definable changes (e.g., sea state increased from Beaufort 3 to Beaufort 4). Position coordinates and Greenwich Mean Times were recorded at the beginning and end of each leg and at about 5 to 8 minute intervals (transect checks) throughout the leg. Positions were also recorded for each sighting and when the aircraft left or returned to the track line. "Search" or "no search" modes were noted for each coordinate position notation and "sighting record numbers" were referenced to specific position notations.

When a sighting was made, the observer notified the recorder who immediately recorded the position and time and assigned a sighting number. Generally, the observer who made the sighting determined if the aircraft should deviate from the track line to investigate that sighting. His judgment was based on several factors: the probable species sighted, size of the school, the probability of relocating the animals under the prevailing conditions, distance of the school from the track line, available "off track" time, gas load, and general operating conditions of the aircraft. For example, whales were seldom "overflown" unless there were indications of associated porpoises. Or, if an observer had sighted a few animals on or near the track line and was

relatively certain that the mammals were either Grampus, Tursiops, or other forms that are not of prime importance in the tuna purse seine fishery, he would convey his "I.D.," estimated numbers, and distance from track line information to the recorder; ask for verification or supplemental data from other observers; and request that the plane continue on its course. If, however, the signs indicated a herd of delphinid dolphins and time and conditions permitted, he would request a deviation from course. If it was decided to leave the trackline, the recorder would switch the GNS mode to "cross track" and record that distance.

Once off track, all observers aided the pilot in relocating the porpoise school. Because of his perspective, the bow observer had the major responsibility. When directly over the school, the recorder would again read the "cross track" distance and then immediately switch to the "position" mode and record that. The perpendicular distance of the porpoise school from the track line can then be computed by calculating the "cross track" readings. For example, the reading before leaving the track line may be "left 0.6 miles" while the reading over the school may be "right 0.5 miles." Thus, the perpendicular distance would be 1.1 miles. Because the plane was flying a series of small great circle routes, it was seldom "on track" and at least three position readings would be necessary to calculate perpendicular distances from coordinates.

If, on the run to the school, it was decided that the school and conditions were conducive for 9-inch photography, the first pass over the school would be made for that purpose. The pass would be made at an altitude of 1000-1500 feet and as slowly as possible. During the run to the school, the camera hatch would be opened, the camera leveled, and the intervalometer controls manned. The bow observer aided the pilot to steer the aircraft on a course that would pass directly over the school, and commanded the camera operator to start and stop the series of pictures. If smoke signals or dye markers were to be used, they were usually jettisoned at this time. Aboard the P2V, the Hasselblad pictures would also be taken and the temperature record notated at this time.

Following the camera pass, the aircraft then descended and circled the school in the best configuration the pilot and plane could perform to allow scrutiny of the school for species identification and estimation of numbers. Because of its flight characteristics, the P2V could not turn in tight circles on a target, but instead it flew a large elliptical course with a close pass near the school at one eccentric point on the course. Generally, the pilot attempted to orient to this point so that the available light illuminated the animals to the best advantage (side lighting). At this point, the pilot would bank the plane to provide the best possible view to the observers. The altitude at such times was generally about 300-500 feet, the speed from 150-190 knots. The PBY, on the other hand, could "point a wing" at the school and turn slowly in continuous circles with the school always in range for observations. Generally, the PBY circled at an altitude of 500-700 feet but occasionally descended lower. The speed would be 95-100 knots. The gyro-stabilized 15-power glasses were most effective as an aid in porpoise identification at the higher altitudes.

The direction of the circle varied depending on whether the plane was being flown from the left or right seat. Aboard the PBY, because the large mess table occupied space in the right blister, the plane generally turned to port where three observers could kneel side-by-side and get an identical unobstructed wide angle view out of the opened port blister. The 35-mm telephoto pictures and motion pictures were taken from the waist positions at this time.

The recorder queried all observers for the appropriate time to break-off circling and return to the track line. Once committed to work a school, the tendency was to invest as much time as was reasonably necessary to obtain satisfactory identifications and number estimates. However, there were times when the safety of the aircraft demanded curtailment of observations. Infrequently, the schools were worked in reverse order--circling around them first and then making a 9-inch camera pass. Because the schools usually reacted to a low flying plane, it was best to photograph them first.

On the return to the track line where the search would be resumed, the recorder began to interrogate all observers for data items to fill out the "Sighting Record Form." This form (Figure 4) is designed for compatability with automatic data processing methods. During this same interim, the person who was responsible for the 9-inch photography quizzed all photographers and filled out a "camera log" (Figure 5) for that sighting. (The 9-inch film was "spaced" between each flight, and information was inscribed on the blank film section with a stylus.)

On occasions when sightings followed in short order, a considerable backlog of information would accumulate, and observers often took brief notes before the search was resumed. (Hand held tape recorders were obtained for the survey but were seldom used.) At times, the recorder would get such a backlog of information that he would finish filling out his accumulated sighting record forms while in the rest position.

Rotation of observers at 40 minute intervals greatly alleviated tedium and fatigue. For the greatest efficiency, however, the system had the drawback that each observer must master at least three jobs, and several flights were necessary before a smooth team effort was achieved. For such long flights (up to 16 hours), however, the advantages far outweighed the shortcomings. Further, before Phase I, we were fortunate in having an opportunity to practice on common dolphin schools off San Diego and in the Gulf of California. The first several flights also had a relatively low sighting frequency. Therefore, the necessary efficiency of operation was achieved fairly quickly.

RESULTS:

Flight Statistics

During the four phases of the survey, 31 flights were made using standardized searching and recording procedures that covered 49,000 nautical miles (nm). The search was discontinued when the aircraft deviated from the track line to investigate a sighting and was not resumed until the plane had returned to its predetermined course. Scouting was also suspended at times when visibility was limited by clouds or rain. (These "no search" modes totalled about 2,200 nm.) Part of these flights were "deadhead," that is,

the aircraft was flying to or from the track line either over land or during hours of inadequate light to search for porpoise schools (approximately 11,841 nm). Thus, about 33,000 linear nm were actively searched.

In addition to the regular flights, two special-purpose flights were conducted in the Gulf of California: a practice flight at the beginning of Phase I while enroute to Mazatlan, Mexico; and an observer-evaluation study at the termination of Phase III while returning from La Paz, Mexico to San Diego, California.

A number of ferry flights covering about 15,000 nm were also necessary to get the aircraft on and off the job or to various locations for repairs. A total of about 64,000 miles was flown in all modes.

The track lines for the flights when the aircraft was actively searching (or when search was temporarily suspended) are shown in Figures 1 and 2. The "dead-head" and ferry tracks are not indicated. The itinerary for these flights are listed above, and the approximate nautical miles flown in the various modes are given in Table 1.

Table 1. APPROXIMATE NAUTICAL MILES (NM) FLOWN DURING THE AERIAL SURVEY - 1977

	MODES				
PHASES	SEARCH	NO-SEARCH	DEADHEAD	SPECIAL	FERRY
I	12,162	1,075	6,441	950	5,570
II	10,195	600	1,380	---	2,830
III	6,656	525	2,320	1,000	100
IV	3,897	---	1,700	---	6,580
TOTALS	32,910	2,200	11,841	1,950	15,080
GRAND TOTAL	63,981				

GUEST PARTICIPANTS:

The following persons took part in the indicated flights:

Flight 8, February 6 - Bio. Amin Zarur Menez, Jefe, Oficina de Pesca de la SIC, State of Guerrero, Mexico.

Flight 12, March 22 - Ing. Luis F. Martinez, Jefe, Division de Fauna, de Guatemala and Ing. Oswaldo Gonsález, FAP Project, Guatemala City, Guatemala.

Flight 14, March 27 - Lt. Umberto Andrade and Lt. Cezar Aguirre, Ecuadorian Air Force, Guayaquil, Ecuador.

Flight 18, April 4 - Bio. Jairo Maldanado, Depto. de Pesca, Columbia.

Flight 19, April 28 - Mr. Stuart Peterson, Fixed Wing Specialist, Office of Aircraft Services, Dept. of the Interior.

Flight 20, April 30 - Biol. Herbert Nanne, Depto. Acuacultura, Pesca Continental y Vida silvestre, Ministerio Agricultura, San Jose, Costa Rica.

Flight 24, May 15 - Mr. Thomas Horton, Business Manager, The Cousteau Society.

Flight 31, June 19 - Dr. Tim Smith, University of Hawaii and the Marine Mammal Commission.

Economic officers at American embassies and consulates were visited in the following cities: Guatemala City, Guatemala; Guayaquil, Ecuador; Lima, Peru; San Jose, Costa Rica.

RESULTS:

Cetaceans

Sightings of marine mammals for Phases I, II and III of the operations are summarized below. (There were no marine mammal sightings during Phase IV.) Nine forms of dolphins were sighted and identified as to species or race and their numbers estimated. There were a total of 176 such sightings. In addition, sightings of 84 dolphin schools were unidentified as to species.

There were 100 sightings of whale species and two unidentified categories of small and large whales.

The individual breakdowns of these sightings for species and categories, their totaled averaged low, high, and best number estimates, and totals of pure and mixed schools are shown in Table 2.

A listing of sightings for each species or category giving the date, flight number, geographical location, and the mean best estimate of aggregations are given in Tables 3 to 24. The distribution of the sightings for species and categories are shown in Figures 6 to 17.

A large number of dolphin sightings were unidentified to species. This was due to several factors. As previously indicated, the flight characteristics of the Neptune aircraft were such that positive identifications were generally only possible after several time-consuming passes, and, at the most, only two observers were in the best station to observe the animals during the fly-by. Thus, on some occasions, time was not available to adequately work the school. On other occasions, only a few animals were noted that did not appear to be spotters, spinners, streakers, or Delphinus and we did not diverge from our course to work them. On still other occasions, small groups could not be relocated after the original sighting. The ratio of identified to unidentified sightings increased during the PBY Phase III flights.

RESULTS:

Sea Surface Temperatures (SST)

The radiation thermometer strip chart recordings for all P2V flights were read at 2 minute intervals and converted to sea surface temperatures based on the inflight calibration data. Five such data points were averaged to provide a mean sea surface temperature over a 10-minute period of flying time (approximately 30 nm of flight distance). For all aircraft locations that had been noted on the strip chart, these averaged sea surface temperatures were plotted and analyzed manually to provide a more detailed picture than is normally available. The composite analysis is shown in Figure 18.

Photography

The objective of the work with the vertically directed cameras was to photograph the animals with enough resolution and contrast so that their individual bodies could be scored on the film and counts compared to the observer estimates of school size.

High contrast foam and splash patterns created by active porpoise herds are of course photographed easily, but generally submerged porpoise bodies will only photograph well during two brief periods of the day. At

these times, the angle of incidence of the sun's rays with the sea surface is low enough so that there will be relatively low reflectance back into the lens, but there will be enough light penetrating the water to illuminate the animals' bodies for the lens and film being used. The chances of encountering a school of porpoise at these times during a low sea state and with the operational time available for photography are not very high, and on many occasions film was exposed under less than ideal conditions.

In collaboration with personnel at the Fishery Engineering Laboratory at the NASA Test Facility in Bay St. Louis, Mississippi, the film has been analyzed on a Variscan Mark II projector at relatively high magnifications. Five rolls of 9-inch film were exposed with the K-17 camera during the first three phases of the survey. During Phase I, Roll No. 1 containing coverage of the first six flights was ruined when the magazine that had been stored in plastic bags in a portable ice box was flooded with melted water. Roll No. 2 covered Flights 6 to 11 and recorded 13 sightings with a total of 83 frames. Seven photographed sequences contained useful information, but only two were considered to be high quality.

On Phase II, Roll No. 3 was incorrectly loaded at the film development facility and as a result did not take up on its storage roll. The film was exposed when the magazine was opened inflight to change film. Roll No. 4 covered Flights 17 and 18 and included nine sightings in a total of 60 frames. Due to either deterioration of the unexposed film or to faulty development, the color contrast of the film was off, and only two sequences recorded useful information. None of these was considered as high quality.

Roll No. 5, taken on Phase III Flights 19 to 27, provided coverage on 20 sightings plus a second sequence on two of these observations. In all, 166 frames were exposed. Useful information was contained on nine sequences and two sequences were considered as highly reliable.

Results from the Phases I and II with the Hasselblad were not as encouraging as those obtained with the 9-inch camera, and the Hasselblad was not used on the PBY during Phase III.

Results with the hand-held 35 mm Nikon camera were markedly better on Phase III when used from the slower flying PBY. Several sequences will provide photographic verification of species determination.

With the 16 mm movie camera, best results were obtained from the PBY using a gyro stabilizer while shooting out of the open blister at 33 frames per second. About 2000 feet of useful footage of the general operation were also taken.

PROBLEMS:

In conjunction with the observations of the R/V David Starr Jordan and the NOAA ship Townsend Cromwell, adequate coverage of the study area was achieved (see Figure 19 for the combined ship and aircraft tracks). Temporal disjunction occurred, however, between the aircraft and ships and the different areas covered by the aircraft. This breakdown in continuity was mainly due to mechanical problems with the planes aggravated by the demanding nature of the flights. Minor delays were also caused by the normal problems of operating in foreign countries away from support facilities.

A summary of events or problems that caused time delays are listed in the appendix.

Date prepared: 12 Oct. 1977

Eric Barham
Fisheries Scientist

Date approved: 10/14/77

Izadore Barrett
Center Director

Table 2. 1977 Aerial Survey: Sighting Summary

SPECIES NAME (SCIENTIFIC NAME)	SPECIES CODE	SIGHTINGS TOTAL	SIGHTINGS PURE	SIGHTINGS MIXED	ESTIMATED-AVERAGED-TOTAL-NUMBERS LOW / N	HIGH / N	BEST / N
OFFSHORE SPOTTED DOLPHIN (STENELLA ATTENUATA)	2	18	11	7	165.81(18)	278.35(18)	220.41(18)
SPINNER DOLPHIN (STENELLA LONGIROSTRIS)	3	4	1	3	90.75(4)	143.63(4)	108.70(4)
COMMON DOLPHIN (DELPHINUS DELPHIS)	5	27	22	5	181.55(28)	314.87(28)	242.17(28)
COASTAL SPOTTED DOLPHIN (S.A. GRAFFMANI)	6	2	2	0	93.00(2)	136.50(2)	107.00(2)
EASTERN SPINNER DOLPHIN (STENELLA LONGIROSTRIS SUBSP.B.)	10	5	4	1	122.40(5)	191.48(5)	151.92(5)
STRIPED DOLPHIN (S. COERULEOALBA)	13	5	3	2	77.00(5)	141.80(5)	108.78(5)
BOTTLENOSED DOLPHINS (TURSIOPS TRUNCATUS)	18	21	14	7	41.11(19)	65.42(19)	49.77(20)
RISSO'S DOLPHIN (GRAMPUS GRISEUS)	21	87	79	8	21.50(84)	34.37(83)	26.37(85)
UNIDENTIFIED DOLPHIN OR PORPOISE	77	84	78	6	35.54(77)	74.37(66)	42.97(67)
COSTA RICAN SPINNER DOLPHIN (STENELLA LONGIROSTRIS SUBSP.A)	88	1	1	0	92.00(1)	193.00(1)	127.00(1)
TOTALS		254	215	39			

Table 2. (Continued)

SPECIES NAME (SCIENTIFIC NAME)	SPECIES CODE	SPECIES SIGHTINGS TOTAL	PURE	MIXED	ESTIMATED-AVERAGED-TOTAL-NUMBERS LOW / N	HIGH / N	BEST / N
FALSE KILLER WHALE (PSEUDORCA CRASSIDENS)	33	2	2	0	5.00(2)	5.00(2)	5.00(2)
PILOT WHALE (GLOBICEPHALA SP.)	34	6	4	2	3.63(6)	4.37(6)	3.85(6)
KILLER WHALE (ORCINAS ORCA)	37	1	1	0	12.00(1)	12.00(1)	12.00(1)
SPERM WHALE (PHYSETER CATODON)	46	21	20	1	4.06(21)	4.51(21)	3.96(20)
BEAKED WHALE (ZIPHIID)	49	3	3	0	19.67(3)	29.33(3)	26.67(3)
RORQUAL (BALAENOPTERA SP.)	70	5	5	0	1.20(5)	1.20(5)	1.20(5)
MINKE WHALE (B.ACUTOROSTRATA,B.BONAERENSIS)	71	1	1	0	12.00(1)	16.00(1)	14.00(1)
BRYDE'S WHALE (B. EDENI)	72	1	1	0	25.00(1)	0. (0)	0. (0)
BLUE WHALE (B. MUSCULUS)	75	1	1	0	1.00(1)	1.00(1)	1.00(1)
HUMPBACK WHALE (MEGAPTERA NOVAEANGLINE)	76	3	2	1	9.96(3)	15.89(3)	13.40(3)
UNIDENTIFIED SMALL WHALE	78	37	32	5	21.83(35)	38.67(31)	27.65(32)
UNIDENTIFIED LARGE WHALE	79	19	19	0	1.32(19)	1.37(19)	1.32(19)
TOTALS		100	91	9			
GRAND TOTALS		354	306	48			

Table 3. 1977 Aerial Survey: Sightings by Species

SPECIES: OFFSHORE SPOTTED DOLPHIN
(STENELLA ATTENUATA)

OBS.#	FLIGHT#	PHASE#	DATE YRMODY	LATITUDE DEG MIN	LONGITUDE DEG MIN	MEAN BEST EST (*=DATA NOT AVAILABLE)
33	8	1	770206	2 46 N	108 17 W	53.
34	8	1	770206	2 21 N	108 32 W	51.
46	9	1	770208	13 17 N	99 20 W	57.
47	9	1	770208	13 42 N	99 16 W	339.
57	10	1	770210	9 42 N	97 37 W	250.
63	10	1	770210	1 56 N	99 44 W	235.
64	10	1	770210	1 38 N	99 50 W	1148.
66	10	1	770210	1 51 N	100 1 W	192.
81	11	1	770213	11 8 N	92 58 W	263.
82	11	1	770213	11 8 N	92 56 W	88.
87	12	2	770322	13 56 N	92 7 W	175.
169	15	2	770329	10 59 S	82 59 W	350.
252	20	3	770430	9 59 N	85 42 W	221.
279	22	3	770511	15 13 N	100 34 W	216.
281	22	3	770511	14 44 N	100 44 W	76.
287	22	3	770511	12 0 N	102 0 W	43.
304	22	3	770511	13 30 N	102 16 W	50.
310	23	3	770513	16 52 N	102 32 W	162.

Table 4. 1977 Aerial Survey: Sightings by Species

SPECIES: COASTAL SPOTTED DOLPHIN
(S.A. GRAFFMANI)

OBS.#	FLIGHT#	PHASE#	DATE YRMODY	LATITUDE DEG MIN	LONGITUDE DEG MIN	MEAN BEST EST (*=DATA NOT AVAILABLE)
217	18	2	770404	7 57 N	79 31 W	174.
218	18	2	770404	8 5 N	79 30 W	40.

Table 5. 1977 Aerial Survey: Sightings by Species

SPECIES: SPINNER DOLPHIN (Unidentified to sub-species)
(STENELLA LONGIROSTRIS)

OBS.#	FLIGHT#	PHASE#	DATE YRMODY	LATITUDE DEG MIN	LONGITUDE DEG MIN	MEAN BEST EST (*=DATA NOT AVAILABLE)
64	10	1	770210	1 38 N	99 50 W	203.
66	10	1	770210	1 51 N	100 1 W	192.
141	14	2	770327	5 12 S	88 42 W	16.
252	20	3	770430	9 59 N	85 42 W	25.

Table 6. 1977 Aerial Survey. Sightings by Species

SPECIES: EASTERN SPINNER DOLPHIN
(STENELLA LONGIROSTRIS SUBSP.B.)

OBS.#	FLIGHT#	PHASE#	DATE YRMODY	LATITUDE DEG	MIN		LONGITUDE DEG	MIN		MEAN BEST EST (*=DATA NOT AVAILABLE)
167	15	2	770329	11	0	S	84	2	W	161.
215	18	2	770404	4	0	N	79	34	W	75.
235	19	3	770428	5	47	N	84	29	W	83.
249	19	3	770428	8	41	N	84	12	W	400.
310	23	3	770513	16	52	N	102	32	W	41.

Table 7. 1977 Aerial Survey: Sightings by Species

SPECIES: COSTA RICAN SPINNER DOLPHIN
(STENELLA LONGIROSTRIS SUBSP.A)

OBS.#	FLIGHT#	PHASE#	DATE YRMODY	LATITUDE DEG MIN	LONGITUDE DEG MIN	MEAN BEST EST (*=DATA NOT AVAILABLE)
207	17	2	770402	9 55 N	85 31 W	127.

Table 8. 1977 Aerial Survey: Sightings by Species

SPECIES: COMMON DOLPHIN
(DELPHINUS DELPHIS)

OBS.#	FLIGHT#	PHASE#	DATE YRMODY	LATITUDE DEG	LATITUDE MIN		LONGITUDE DEG	LONGITUDE MIN		MEAN BEST EST (*=DATA NOT AVAILABLE)
12	2	1	770123	22	53	N	109	31	W	40.
99	12	2	770322	1	51	N	95	13	W	45.
102	12	2	770322	2	19	N	94	34	W	23.
122	13	2	770324	2	56	S	88	0	W	240.
124	13	2	770324	3	6	S	88	0	W	22.
130	13	2	770324	2	46	S	83	2	W	83.
131	13	2	770324	2	32	S	82	1	W	60.
180	17	2	770402	10	51	S	78	31	W	386.
181	17	2	770402	10	40	S	78	41	W	800.
187	17	2	770402	7	53	S	81	37	W	42.
203	17	2	770402	8	52	N	85	34	W	660.
204	17	2	770402	8	50	N	85	36	W	470.
206	17	2	770402	9	28	N	85	31	W	127.
263	21	3	770510	8	52	N	98	2	W	238.
264	21	3	770510	8	39	N	98	6	W	48.
269	21	3	770510	9	19	N	100	0	W	60.
306	23	3	770513	16	48	N	100	40	W	92.
324	25	3	770516	21	42	N	106	55	W	70.
329	27	3	770518	24	21	N	110	23	W	800.
330	27	3	770518	24	27	N	110	24	W	298.
332	27	3	770518	25	39	N	110	58	W	162.
333	27	3	770518	25	44	N	111	11	W	317.
334	27	3	770518	25	15	N	111	2	W	641.
335	27	3	770518	26	12	N	111	20	W	306.
336	27	3	770518	28	12	N	111	54	W	85.
337	27	3	770518	28	15	N	112	8	W	153.
338	27	3	770518	28	46	N	112	54	W	476.

Table 9. 1977 Aerial Survey: Sightings by Species

SPECIES: STRIPED DOLPHIN
(S. COERULEOALBA)

OBS.#	FLIGHT#	PHASE#	DATE YRMODY	LATITUDE DEG MIN	LONGITUDE DEG MIN	MEAN BEST EST (*=DATA NOT AVAILABLE)
17	3	1	770125	18 53 N	115 16 W	50.
81	11	1	770213	11 8 N	92 58 W	29.
122	13	2	770324	2 56 S	88 0 W	27.
236	19	3	770428	4 54 N	84 30 W	175.
237	19	3	770428	4 21 N	84 30 W	263.

Table 10. 1977 Aerial Survey: Sightings by Species

SPECIES: BOTTLENOSED DOLPHINS
(TURSIOPS TRUNCATUS)

OBS.#	FLIGHT#	PHASE#	DATE YRMODY	LATITUDE DEG MIN	LONGITUDE DEG MIN	MEAN BEST EST (*=DATA NOT AVAILABLE)
18	3	1	770125	20 43 N	105 34 W	29.
28	7	1	770204	16 14 N	103 27 W	2.
49	9	1	770208	16 10 N	98 14 W	38.
51	9	1	770208	15 32 N	99 36 W	222.
112	13	2	770324	13 4 N	89 27 W	14.
126	13	2	770324	3 56 S	87 43 W	15.
129	13	2	770324	2 51 S	83 23 W	8.
146	15	2	770329	12 1 S	78 49 W	15.
147	15	2	770329	12 1 S	79 21 W	2.
148	15	2	770329	12 0 S	79 25 W	8.
150	15	2	770329	12 1 S	80 13 W	3.
180	17	2	770402	10 51 S	78 31 W	20.
263	21	3	770510	8 52 N	98 2 W	13.
312	23	3	770513	16 59 N	103 50 W	50.
314	23	3	770513	16 52 N	104 8 W	23.
318	23	3	770513	10 32 N	109 18 W	38.
323	25	3	770516	20 42 N	105 36 W	399.
327	26	3	770517	21 16 N	117 4 W	25.
330	27	3	770518	24 27 N	110 24 W	16.
333	27	3	770518	25 44 N	111 11 W	56.
339	27	3	770518	29 22 N	112 48 W	37.

Table 11. 1977 Aerial Survey: Sightings by Species

SPECIES: RISSO'S DOLPHIN
(GRAMPUS GRISEUS)

OBS.#	FLIGHT#	PHASE#	DATE YRMODY	LATITUDE DEG MIN	LONGITUDE DEG MIN	MEAN BEST EST (*=DATA NOT AVAILABLE)
22	7	1	770204	5 25 N	112 4 W	5.
23	7	1	770204	6 9 N	111 36 W	6.
24	7	1	770204	6 19 N	111 32 W	4.
32	8	1	770206	14 42 N	101 25 W	93.
45	9	1	770208	11 37 N	100 11 W	12.
46	9	1	770208	13 17 N	99 20 W	6.
54	10	1	770210	12 6 N	96 57 W	20.
56	10	1	770210	10 40 N	97 23 W	65.
58	10	1	770210	4 4 N	99 9 W	1.
59	10	1	770210	2 44 N	99 31 W	95.
61	10	1	770210	2 29 N	99 35 W	5.
69	10	1	770210	2 55 N	100 45 W	24.
71	10	1	770210	3 46 N	100 40 W	4.
72	10	1	770210	4 20 N	100 38 W	18.
76	11	1	770213	11 3 N	95 24 W	20.
77	11	1	770213	8 6 N	96 51 W	3.
83	11	1	770213	11 10 N	92 53 W	1.
86	11	1	770213	12 31 N	91 51 W	14.
104	12	2	770322	2 39 N	94 10 W	1.
106	12	2	770322	2 48 N	93 59 W	1.
111	12	2	770322	12 32 N	91 4 W	1.
114	13	2	770324	11 5 N	89 36 W	17.
121	13	2	770324	1 48 S	88 0 W	1.
123	13	2	770324	2 59 S	88 0 W	14.
127	13	2	770324	3 29 S	85 53 W	11.
128	13	2	770324	3 7 S	84 26 W	20.
132	14	2	770327	3 19 S	81 22 W	3.
133	14	2	770324	3 23 S	81 28 W	0.*

Table 11. (Continued)

SPECIES: RISSO'S DOLPHIN
(GRAMPUS GRISEUS)

OBS.#	FLIGHT#	PHASE#	DATE YRMODY	LATITUDE DEG MIN	LONGITUDE DEG MIN	MEAN BEST EST (*=DATA NOT AVAILABLE)
134	14	2	770327	3 52 S	82 12 W	3.
135	14	2	770327	4 3 S	82 28 W	7.
136	14	2	770327	4 10 S	82 40 W	29.
137	14	2	770327	4 11 S	82 41 W	5.
138	14	2	770327	5 5 S	83 59 W	20.
143	14	2	770327	4 24 S	86 32 W	1.
148	15	2	770329	12 0 S	79 25 W	8.
149	15	2	770329	12 1 S	80 7 W	11.
151	15	2	770329	12 0 S	80 35 W	8.
152	15	2	770329	12 0 S	81 29 W	14.
154	15	2	770329	12 1 S	82 35 W	14.
155	15	2	770329	12 1 S	82 37 W	38.
156	15	2	770329	12 0 S	83 18 W	9.
157	15	2	770329	12 0 S	83 44 W	25.
158	15	2	770329	12 0 S	84 40 W	1.
159	15	2	770329	12 0 S	85 11 W	22.
160	15	2	770329	12 0 S	86 12 W	18.
162	15	2	770329	11 58 S	86 33 W	6.
166	15	2	770329	11 0 S	85 59 W	14.
168	15	2	770329	11 1 S	83 25 W	13.
170	15	2	770329	11 4 S	80 43 W	4.
171	15	2	770329	11 7 S	80 32 W	4.
175	16	2	770331	14 7 S	80 10 W	2.
177	16	2	770331	13 37 S	86 5 W	15.
182	17	2	770402	9 51 S	79 29 W	16.
184	17	2	770402	9 9 S	80 12 W	4.
189	17	2	770402	7 3 S	82 36 W	1.
190	17	2	770402	6 48 S	82 58 W	4.

Table 11. (Continued)

SPECIES: RISSO'S DOLPHIN
(GRAMPUS GRISEUS)

OBS.#	FLIGHT#	PHASE#	DATE YRMODY	LATITUDE DEG MIN	LONGITUDE DEG MIN	MEAN BEST EST (*=DATA NOT AVAILABLE)
191	17	2	770402	6 47 S	83 0 W	2.
192	17	2	770402	6 43 S	83 5 W	12.
193	17	2	770402	6 39 S	83 10 W	3.
194	17	2	770402	6 36 S	83 14 W	23.
196	17	2	770402	5 41 S	84 23 W	9.
199	17	2	770402	2 2 N	85 42 W	3.
205	17	2	770402	9 10 N	85 32 W	6.
208	18	2	770404	9 3 N	84 31 W	50.
209	18	2	770404	7 33 N	84 31 W	22.
221	19	3	770428	9 4 N	84 30 W	50.
222	19	3	770428	8 55 N	84 30 W	14.
225	19	3	770428	8 12 N	84 34 W	784.
233	19	3	770428	6 19 N	84 30 W	25.
234	19	3	770428	5 56 N	84 31 W	0.*
240	19	3	770428	4 32 N	82 20 W	14.
241	19	3	770428	5 8 N	82 5 W	7.
243	19	3	770428	5 45 N	82 29 W	9.
244	19	3	770428	6 24 N	82 44 W	15.
247	19	3	770428	8 9 N	84 3 W	36.
248	19	3	770428	8 17 N	84 6 W	123.
259	21	3	770510	11 4 N	97 18 W	35.
267	21	3	770510	9 5 N	99 59 W	81.
270	21	3	770510	9 33 N	99 58 W	8.
285	22	3	770511	12 43 N	101 41 W	30.
291	22	3	770511	9 52 N	103 6 W	48.
299	22	3	770511	10 32 N	103 40 W	8.
300	22	3	770511	10 38 N	103 36 W	6.
305	23	3	770513	16 45 N	100 13 W	25.

Table 11. (Continued)

SPECIES: RISSO'S DOLPHIN
(GRAMPUS GRISEUS)

OBS.#	FLIGHT#	PHASE#	DATE YRMODY	LATITUDE DEG MIN	LONGITUDE DEG MIN	MEAN BEST EST (*=DATA NOT AVAILABLE)
307	23	3	770513	16 47 N	100 45 W	8.
308	23	3	770513	16 45 N	101 36 W	2.
309	23	3	770513	10 46 N	101 41 W	2.

Table 12. 1977 Aerial Survey: Sightings by Species

SPECIES: UNIDENTIFIED DOLPHIN OR PORPOISE

OBS.#	FLIGHT#	PHASE#	DATE YRMODY	LATITUDE DEG MIN	LONGITUDE DEG MIN	MEAN BEST EST (*=DATA NOT AVAILABLE)
13	2	1	770123	22 48 N	109 54 W	12.
16	3	1	770125	17 58 N	117 3 W	100.
19	4	1	770126	17 42 N	111 39 W	0.*
25	7	1	770204	7 4 N	110 59 W	218.
27	7	1	770204	14 59 N	104 33 W	0.*
29	7	1	770205	17 35 N	102 12 W	10.
30	7	1	770205	17 35 N	102 12 W	15.
35	8	1	770206	2 31 N	108 24 W	40.
48	9	1	770208	15 9 N	98 39 W	4.
60	10	1	770210	2 33 N	99 38 W	25.
68	10	1	770210	2 45 N	100 45 W	8.
70	10	1	770210	3 19 N	100 43 W	0.*
74	11	1	770213	15 11 N	94 7 W	65.
78	11	1	770213	9 11 N	94 36 W	300.
80	11	1	770213	9 23 N	94 15 W	1.
84	11	1	770213	11 22 N	92 46 W	0.*
85	11	1	770213	11 25 N	92 39 W	0.*
89	12	2	770322	12 54 N	92 26 W	0.*
92	12	2	770322	11 40 N	92 49 W	20.
93	12	2	770322	11 30 N	92 52 W	0.*
98	12	2	770322	2 45 N	95 25 W	25.
100	12	2	770322	1 51 N	95 13 W	40.
101	12	2	770322	1 55 N	95 10 W	1.
103	12	2	770322	2 30 N	94 23 W	12.
105	12	2	770322	2 46 N	94 2 W	5.
108	12	2	770322	2 55 N	93 50 W	80.
109	12	2	770322	10 34 N	91 19 W	5.
110	12	2	770322	11 1 N	91 15 W	18.

Table 12. (Continued)

SPECIES: UNIDENTIFIED DOLPHIN OR PORPOISE

OBS.#	FLIGHT#	PHASE#	DATE YRMODY	LATITUDE DEG	MIN		LONGITUDE DEG	MIN		MEAN BEST EST (*=DATA NOT AVAILABLE)
113	13	2	770324	12	32	N	89	29	W	26.
115	13	2	770324	9	56	N	89	42	W	60.
116	13	2	770324	5	1	N	89	59	W	13.
119	13	2	770324	0	45	S	88	18	W	275.
120	13	2	770324	1	50	S	88	0	W	0.*
125	13	2	770324	3	36	S	88	1	W	73.
139	14	2	770327	5	38	S	84	44	W	58.
140	14	2	770327	6	57	S	92	18	W	25.
142	14	2	770327	4	43	S	87	23	W	8.
144	14	2	770327	4	15	S	86	10	W	4.
163	15	2	770329	12	0	S	87	7	W	15.
164	15	2	770329	12	0	S	87	25	W	12.
176	16	2	770331	15	25	S	91	28	W	0.*
178	16	2	770331	12	47	S	81	39	W	0.*
179	16	2	770331	12	37	S	80	36	W	0.*
185	17	2	770402	8	49	S	80	37	W	20.
210	18	2	770404	7	24	N	84	31	W	32.
212	18	2	770404	6	43	N	84	31	W	30.
214	18	2	770404	3	59	N	82	1	W	0.*
219	18	2	770404	8	15	N	79	36	W	0.*
220	19	3	770428	9	17	N	84	30	W	85.
225	19	3	770428	8	12	N	84	34	W	16.
228	19	3	770428	7	43	N	84	29	W	5.
231	19	3	770428	6	50	N	84	30	W	17.
232	19	3	770428	6	23	N	84	30	W	1.
242	19	3	770428	5	22	N	82	22	W	4.
246	19	3	770428	8	0	N	84	0	W	2.
250	19	3	770428	8	42	N	84	11	W	163.

Table 12. (Continued)

SPECIES: UNIDENTIFIED DOLPHIN OR PORPOISE

OBS.#	FLIGHT#	PHASE#	DATE YRMODY	LATITUDE DEG MIN	LONGITUDE DEG MIN	MEAN BEST EST (*=DATA NOT AVAILABLE)
251	20	3	770430	9 51 N	85 23 W	8.
256	20	3	770430	14 48 N	95 36 W	18.
261	21	3	770510	9 50 N	97 44 W	6.
262	21	3	770510	9 28 N	97 50 W	3.
266	21	3	770510	8 21 N	100 0 W	4.
267	21	3	770510	9 5 N	99 59 W	54.
272	21	3	770510	10 27 N	100 0 W	25.
275	21	3	770510	14 16 N	99 52 W	3.
276	21	3	770510	14 34 N	99 51 W	8.
278	22	3	770511	16 26 N	99 56 W	1.
280	22	3	770511	15 16 N	100 36 W	25.
284	22	3	770511	13 7 N	101 29 W	1.
286	22	3	770511	12 22 N	101 50 W	24.
288	22	3	770511	10 50 N	102 35 W	100.
289	22	3	770511	10 21 N	102 48 W	70.
290	22	3	770511	10 5 N	102 58 W	10.
295	22	3	770511	8 27 N	103 48 W	200.
296	22	3	770511	7 39 N	104 11 W	0.*
303	22	3	770511	12 24 N	102 48 W	3.
305	23	3	770513	16 45 N	100 13 W	5.
309	23	3	770513	10 46 N	101 41 W	4.
315	23	3	770513	16 27 N	104 28 W	4.
316	23	3	770513	16 22 N	104 33 W	4.
317	23	3	770513	16 17 N	104 36 W	0.*
319	23	3	770513	10 53 N	109 49 W	0.*
320	23	3	770513	11 2 N	109 45 W	1.
322	24	3	770515	16 15 N	113 27 W	350.
326	26	3	770517	19 43 N	117 43 W	0.*

Table 13. 1977 Aerial Survey: Sightings by Species

SPECIES: PILOT WHALE
(*GLOBICEPHALA* SP.)

OBS.#	FLIGHT#	PHASE#	DATE YRMODY	LATITUDE DEG	LATITUDE MIN		LONGITUDE DEG	LONGITUDE MIN		MEAN BEST EST (*=DATA NOT AVAILABLE)
43	9	1	770208	9	33	N	101	2	W	1.
136	14	2	770327	4	10	S	82	40	W	1.
148	15	2	770329	12	0	S	79	25	W	4.
172	16	2	770331	12	23	S	77	38	W	1.
265	21	3	770510	7	57	N	99	51	W	6.
331	27	3	770518	25	14	N	110	40	W	10.

Table 14. 1977 Aerial Survey: Sightings by Species

SPECIES: FALSE KILLER WHALE
(PSEUDORCA CRASSIDENS)

OBS.#	FLIGHT#	PHASE#	DATE YRMODY	LATITUDE DEG MIN	LONGITUDE DEG MIN	MEAN BEST EST (*=DATA NOT AVAILABLE)
41	9	1	770208	6 44 N	102 10 W	5.
42	9	1	770208	7 21 N	101 57 W	5.

Table 15. 1977 Aerial Survey: Sightings by Species

SPECIES: KILLER WHALE
(ORCINAS ORCA)

OBS.#	FLIGHT#	PHASE#	DATE YRMODY	LATITUDE DEG MIN	LONGITUDE DEG MIN	MEAN BEST EST (*=DATA NOT AVAILABLE)
65	10	I	770210	1 36 N	99 50 W	12.

Table 16. 1977 Aerial Survey: Sightings by Species

SPECIES: BEAKED WHALE
(ZIPHIID)

OBS.#	FLIGHT#	PHASE#	DATE YRMODY	LATITUDE DEG MIN	LONGITUDE DEG MIN	MEAN BEST EST (*=DATA NOT AVAILABLE)
161	15	2	770329	11 59 S	86 24 W	18.
211	18	2	770404	7 6 N	84 31 W	32.
213	18	2	770404	4 1 N	82 20 W	30.

Table 17. 1977 Aerial Survey: Sightings by Species

SPECIES: SPERM WHALE
(PHYSETER CATODON)

OBS.#	FLIGHT#	PHASE#	DATE YRMODY	LATITUDE DEG	LATITUDE MIN		LONGITUDE DEG	LONGITUDE MIN		MEAN BEST EST (*=DATA NOT AVAILABLE)
31	8	1	770206	15	23	N	100	58	W	1.
51	9	1	770208	15	32	N	99	36	W	9.
52	9	1	770208	15	17	N	100	14	W	1.
53	10	1	770210	12	44	N	96	49	W	1.
90	12	2	770322	12	31	N	92	34	W	0.*
91	12	2	770322	11	48	N	92	46	W	4.
97	12	2	770322	2	51	N	95	23	W	1.
117	13	2	770324	2	11	N	90	10	W	6.
118	13	2	770324	0	6	N	89	10	W	14.
183	17	2	770402	9	42	S	79	39	W	8.
186	17	2	770402	7	58	S	81	28	W	3.
195	17	2	770402	6	20	S	83	33	W	3.
197	17	2	770402	0	27	S	85	45	W	3.
198	17	2	770402	0	59	N	85	42	W	1.
216	18	2	770404	7	18	N	79	31	W	4.
238	19	3	770428	3	45	N	83	29	W	5.
239	19	3	770428	4	14	N	82	25	W	7.
254	20	3	770430	11	54	N	89	13	W	2.
255	20	3	770430	12	55	N	91	49	W	2.
271	21	3	770510	9	39	N	100	0	W	1.
283	22	3	770511	13	10	N	101	27	W	3.

Table 18. 1977 Aerial Survey: Sightings by Species

SPECIES: RORQUAL (Unidentified to species)
(*BALAENOPTERA* SP.)

OBS.#	FLIGHT#	PHASE#	DATE YRMODY	LATITUDE DEG MIN	LONGITUDE DEG MIN	MEAN BEST EST (*=DATA NOT AVAILABLE)
11	2	1	770123	23 20 N	107 13 W	1.
15	2	1	770123	20 48 N	117 52 W	1.
55	10	1	770210	11 27 N	97 10 W	1.
67	10	1	770210	1 57 N	100 10 W	2.
75	11	1	770213	13 31 N	94 40 W	1.

Table 19. 1977 Aerial Survey: Sightings by Species

SPECIES: MINKE WHALE
(B.ACUTOROSTRATA,B.BONAERENSIS)

OBS.#	FLIGHT#	PHASE#	DATE YRMODY	LATITUDE DEG	MIN	LONGITUDE DEG	MIN	MEAN BEST EST (*=DATA NOT AVAILABLE)
153	15	2	770329	12	0 S	81	46 W	14.

Table 20. 1977 Aerial Survey: Sightings by Species

SPECIES: BRYDE'S WHALE
(*B. EDENI*)

OBS.#	FLIGHT#	PHASE#	DATE YRMODY	LATITUDE DEG MIN	LONGITUDE DEG MIN	MEAN BEST EST (*=DATA NOT AVAILABLE)
20	4	1	770126	17 32 N	111 53 W	0.*

Table 21. 1977 Aerial Survey: Sightings by Species

SPECIES: BLUE WHALE
(*B. MUSCULUS*)

OBS.#	FLIGHT#	PHASE#	DATE YRMODY	LATITUDE DEG MIN	LONGITUDE DEG MIN	MEAN BEST EST (*=DATA NOT AVAILABLE)
39	9	1	770208	6 50 N	102 59 W	1.

Table 22. 1977 Aerial Survey: Sightings by Species

SPECIES: HUMPBACK WHALE
(MEGAPTERA NOVAEANGLINE)

OBS.#	FLIGHT#	PHASE#	DATE YRMODY	LATITUDE DEG MIN	LONGITUDE DEG MIN	MEAN BEST EST (*=DATA NOT AVAILABLE)
18	3	1	770125	20 43 N	105 34 W	1.
50	9	1	770208	16 4 N	98 25 W	38.
224	19	3	770428	8 26 N	84 30 W	1.

Table 23. 1977 Aerial Survey: Sightings by Species

SPECIES: UNIDENTIFIED SMALL WHALE

OBS.#	FLIGHT#	PHASE#	DATE YRMODY	LATITUDE DEG	LATITUDE MIN		LONGITUDE DEG	LONGITUDE MIN		MEAN BEST EST (*=DATA NOT AVAILABLE)
21	4	1	770126	15	59	N	114	30	W	2.
26	7	1	770204	7	59	N	110	15	W	2.
37	8	1	770206	9	26	N	104	18	W	4.
38	8	1	770206	11	4	N	103	18	W	1.
40	9	1	770208	5	23	N	103	24	W	5.
44	9	1	770208	10	0	N	100	50	W	0.*
62	10	1	770210	2	19	N	99	37	W	0.*
73	10	1	770210	7	2	N	100	22	W	0.*
79	11	1	770213	9	25	N	94	19	W	2.
94	12	2	770322	8	6	N	93	51	W	4.
96	12	2	770322	4	14	N	94	59	W	2.
107	12	2	770322	2	52	N	93	55	W	2.
120	13	2	770324	1	50	S	88	0	W	0.*
165	15	2	770329	11	59	S	89	55	W	4.
178	16	2	770331	12	47	S	81	39	W	0.*
202	17	2	770402	8	48	N	85	31	W	3.
223	19	3	770428	8	30	N	84	30	W	1.
229	19	3	770428	7	23	N	84	31	W	1.
230	19	3	770428	7	14	N	84	30	W	3.
245	19	3	770428	6	46	N	82	51	W	1.
252	20	3	770430	9	59	N	85	42	W	2.
257	20	3	770430	15	50	N	97	43	W	2.
260	21	3	770510	10	17	N	97	35	W	1.
270	21	3	770510	9	33	N	99	58	W	792.
273	21	3	770510	10	43	N	100	1	W	1.
274	21	3	770510	13	57	N	99	52	W	2.
279	22	3	770511	15	13	N	100	34	W	2.
282	22	3	770511	14	40	N	100	45	W	1.

Table 23. (Continued)

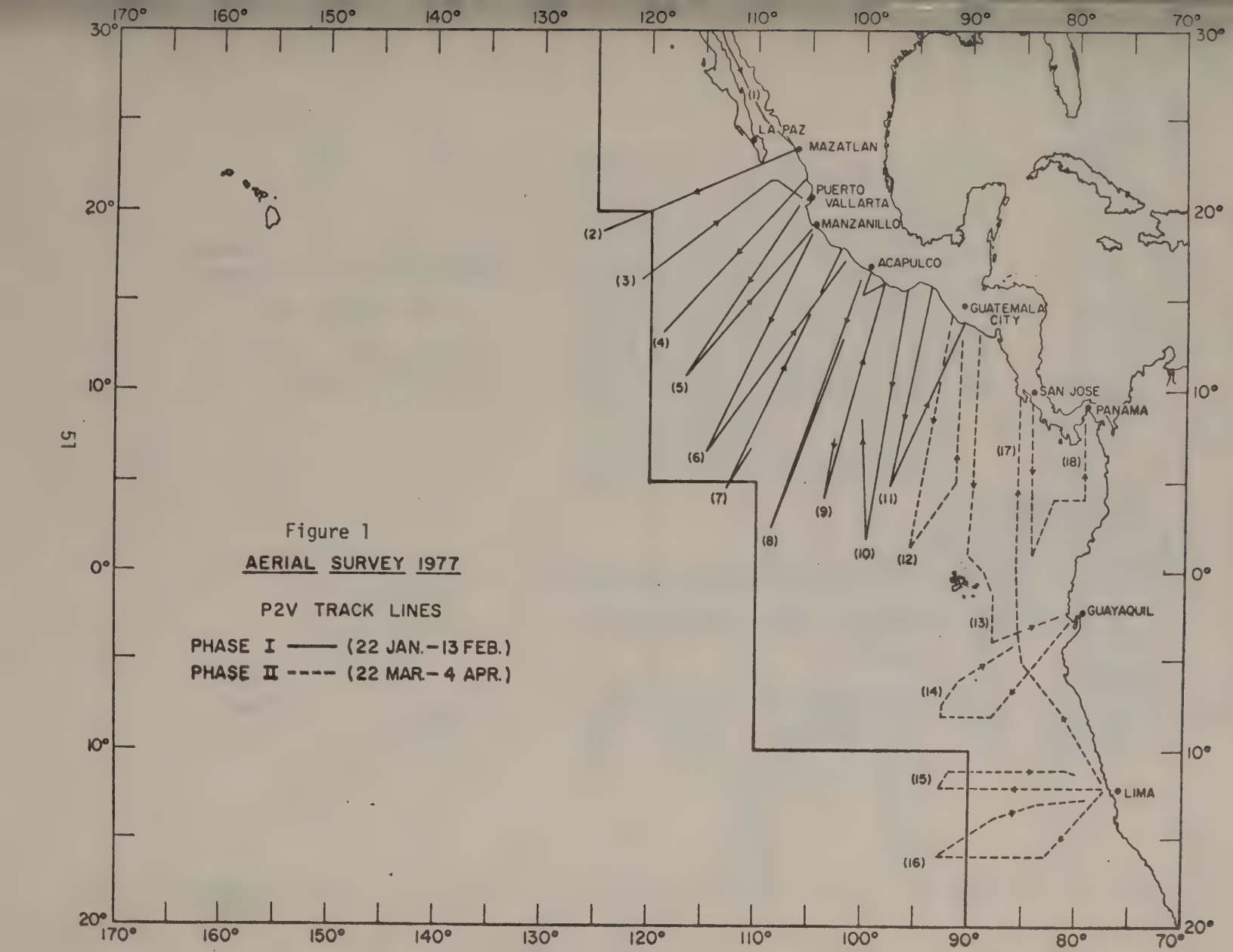
SPECIES: UNIDENTIFIED SMALL WHALE

OBS.#	FLIGHT#	PHASE#	DATE YRMODY	LATITUDE DEG MIN	LONGITUDE DEG MIN	MEAN BEST EST (*=DATA NOT AVAILABLE)
293	22	3	770511	8 55 N	103 31 W	13.
294	22	3	770511	8 50 N	103 33 W	15.
297	22	3	770511	8 34 N	104 44 W	1.
301	22	3	770511	11 45 N	103 10 W	1.
302	22	3	770511	12 3 N	102 58 W	3.
311	23	3	770513	16 58 N	103 12 W	3.
313	23	3	770513	16 58 N	104 4 W	2.
325	25	3	770516	22 24 N	108 50 W	5.
328	26	3	770517	22 56 N	113 12 W	1.

Table 24. 1977 Aerial Survey: Sightings by Species

SPECIES: UNIDENTIFIED LARGE WHALE

OBS.#	FLIGHT#	PHASE#	DATE YRMODY	LATITUDE DEG MIN	LONGITUDE DEG MIN	MEAN BEST EST (*=DATA NOT AVAILABLE)
14	2	1	770123	22 8 N	112 51 W	1.
36	8	1	770206	8 35 N	104 38 W	1.
88	12	2	770322	13 31 N	92 16 W	1.
95	12	2	770322	6 15 N	94 25 W	1.
145	15	2	770329	12 6 S	78 2 W	1.
173	16	2	770331	13 39 S	79 30 W	1.
174	16	2	770331	13 43 S	79 35 W	2.
188	17	2	770402	7 23 S	82 11 W	1.
200	17	2	770402	2 34 N	85 41 W	1.
201	17	2	770402	3 43 N	85 38 W	1.
226	19	3	770428	7 50 N	84 30 W	2.
227	19	3	770428	7 46 N	84 30 W	2.
253	20	3	770430	10 54 N	86 51 W	1.
258	21	3	770510	11 50 N	97 3 W	1.
268	21	3	770510	9 12 N	100 0 W	1.
277	21	3	770510	15 57 N	99 47 W	2.
292	22	3	770511	9 34 N	103 14 W	1.
298	22	3	770511	10 2 N	103 58 W	1.
321	24	3	770515	17 17 N	110 49 W	3.


170°
160°
150°
140°
130°
120°
110°
100°
90°
80°
70°
30°
20°
10°
0°
LA PAZ
MAZATLAN
PUERTO VALLARTA
MANZANILLO
ACAPULCO
GUATEMALA CITY
SAN JOSE
PANAMA
GUAYAQUIL
LIMA
(1)
(2)
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(13)
(14)
(15)
(16)
(17)
(18)
Figure 1
AERIAL SURVEY 1977
P2V TRACK LINES
PHASE I —— (22 JAN.–13 FEB.)
PHASE II ---- (22 MAR.–4 APR.)

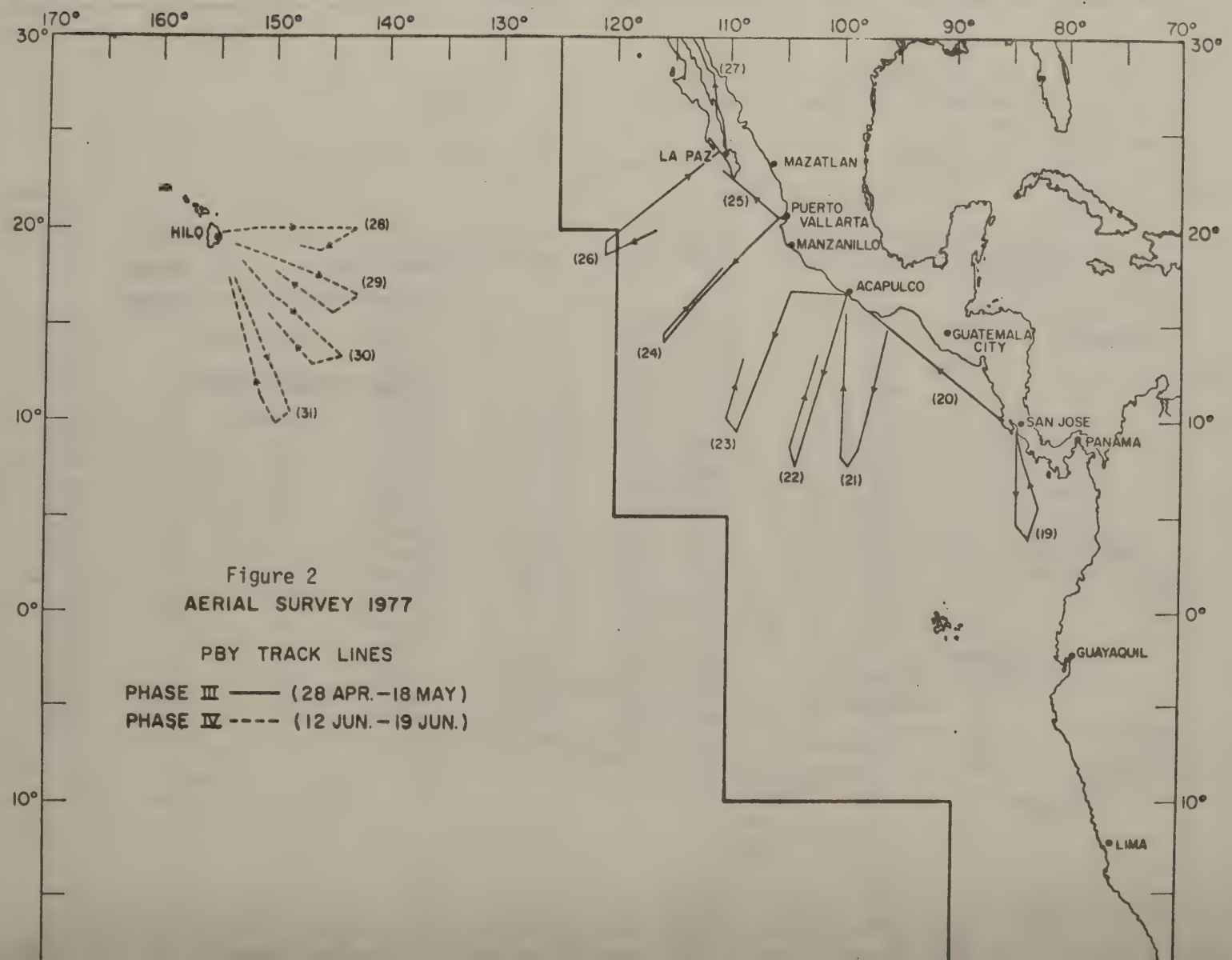

Figure 2
AERIAL SURVEY 1977

PBY TRACK LINES

PHASE III —— (28 APR.–18 MAY)
PHASE IV ---- (12 JUN.–19 JUN.)

1977 Aerial Survey Transect Record

Flight 17 Leg 20 Date 11/2/77

From Lima To S.J.

Blanks	Flight No.	Leg No.	YR	MO	DAY	Altitude (Ft)	Ground Speed (Kts)	Bow	Observer Codes: Blank	Left Observer	Right Observer	Recorder	Sun Position: Horizontal	Sun Position: Vertical	Beaufort No.
	17	20	77	04	02	1500	184	02	X	06	07	08	09	02	2

Position LAT Deg	LAT Min	N/S	LONG Deg	LONG Min	E/W	GMT	Reason for Position Record: 1=Begin Leg, 2=Time Ck, 3=Divert, 4=Over school, 5=Return, 6=End Leg	Searching? Y/N	Sighting No.
08	30.1	1	085	36.9	2	21300	1	1	1-1
08	36.9	1	085	32.5	2	21353	2	1	
08	47.9	1	085	31.4	2	21395	2	1	202
08	53.7	1	085	31.7	2	21414	2	2	
08	52.4	1	085	34.2	2	21453	2	2	203
08	50.4	1	085	36.1	2	21444	2	2	204
08	55.7	1	085	32.2	2	21554	2	2	
						21561	3	2	
08	56.1	1	085	31.8	2	22033	5	1	
09	10.2	1	085	32.3	2	22070	5	1	205
09	28.2	1	085	30.8	2	22139	5	2	206
09	30.3	1	085	29.0	2	22192	5	1	
09	51.4	1	085	30.9	2	22265	5	2	
09	54.6	1	085	30.8	2	22273	5	2	207
09	54.6	1	085	30.9	2	22273	6	2	

Check
R: 1.3
L 1.3
L:3 +/.
2.6 miles

- Flown 3...
- photos
- photos.
- movie photos of 203 Bachman
- End Stra...

204

203

Figure 3

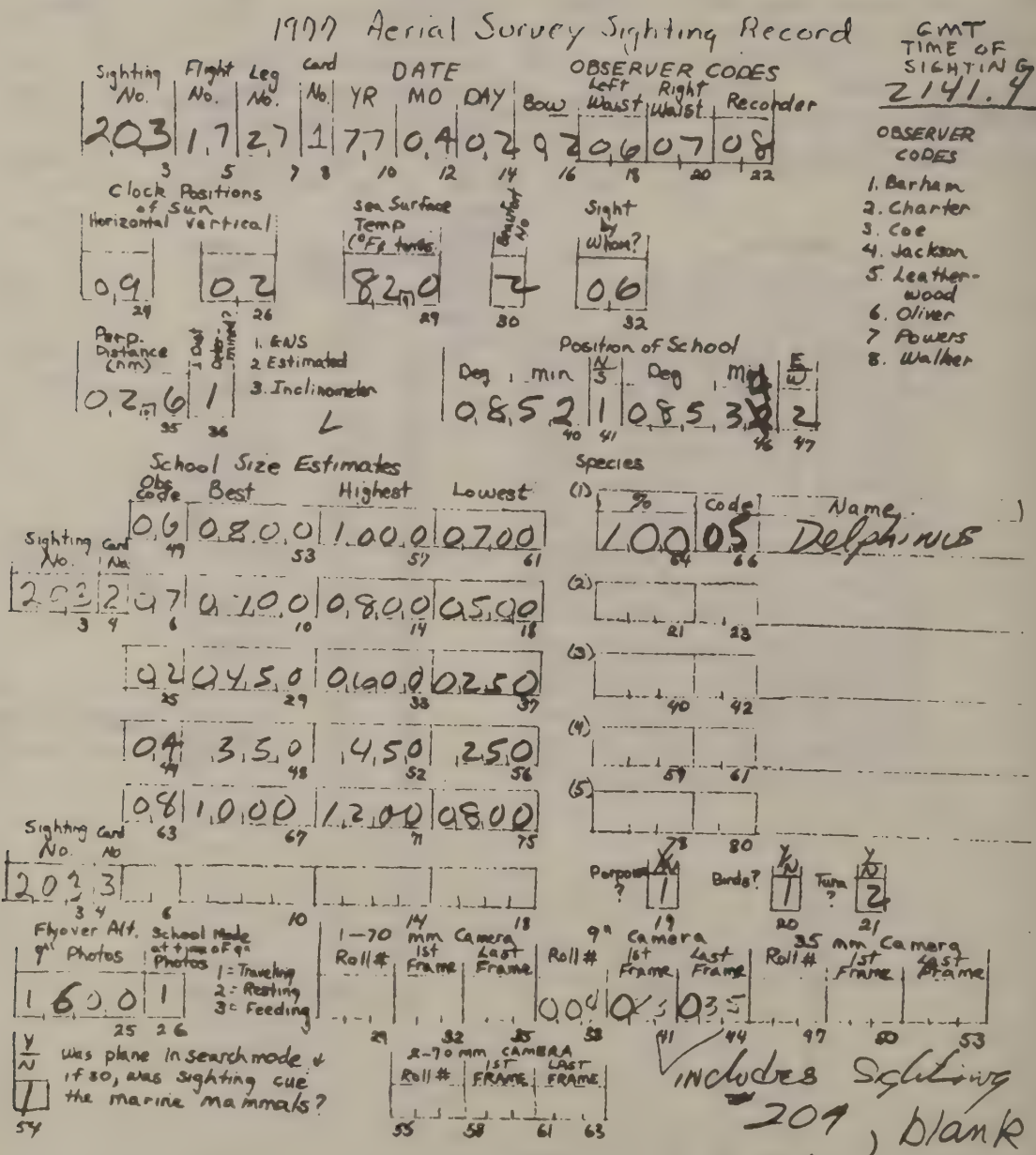
1977 Aerial Survey Sighting Record
GMT TIME OF SIGHTING 2141.9
Sighting No. 203
Flight No. 17
Leg No. 27
Card No. 1
DATE YR 77 MO 04 DAY 02
OBSERVER CODES Bow 9 Left Waist 06 Right Waist 07 Recorder 08
OBSERVER CODES
1. Barham
2. Charter
3. Coe
4. Jackson
5. Leatherwood
6. Oliver
7. Powers
8. Walker
Clock Positions of Sun Horizontal 09 Vertical 02
Sea Surface Temp (°F) tenths 820
Beaufort 4
Sight by whom? 06
Perp. Distance (nm) 0.26
Dist. Det. 1
1. GNS
2. Estimated
3. Inclinometer
L
Position of School Deg 085 min 21 N/S 1 Deg 085 min 33 E/W 2
School Size Estimates
Obs Code 06 Best 080.0 Highest 100.0 Lowest 07.00
Species (1) % 100 Code 05 Name Delphinus
Sighting No. 203 Card No. 2
07 10.0 08.0 05.00
02 04.5.0 06.0 02.50
04 3.5.0 4.5.0 2.5.0
08 10.00 12.00 08.00
Sighting No. 203 Card No. 3
(2) (3) (4) (5)
Porpoise? Y 1 Birds? Y 1 Turtles? Y 2
Flyover Alt. 9" Photos 160 School Mode at time of 9" Photos 1 1=Traveling 2=Resting 3=Feeding
1-70 mm Camera Roll # 1st Frame Last Frame
9" Camera Roll # 004 1st Frame 034 Last Frame
35 mm Camera Roll # 1st Frame Last Frame
Y/N 1 Was plane in search mode if so, was sighting cue the marine mammals?
2-70 mm CAMERA Roll # 1ST FRAME LAST FRAME
Includes Sighting 203, blank filed in between with 1 and under a mile

Figure 4

1977 Aerial Survey Camera Log

Page 5

Flight number 12 Sighting # 203/204

Date April 7, 1977

NOTE ALTITUDE, f/stop, shutter speed, ASA, % of school photographed, etc. when possible

~Time of Sighting (note local or GMT) 1411.4

9" CAMERA

CAMERA BODY # 0960

Intervalometer # BEGIN 023

END 035

Made a pass over the first school sighting #203, took 8-9 [illegible] pictures were fixed well on hand to seperate. The plane continued on to sighting #204 + took what I thought to be 35 including blank.

Hasselblad CAMERA

Roll # 39 Frames 2

Roll # _____ Frames _____

Roll # _____ Frames _____

35mm CAMERA

Roll # 36 Frames 6

MOVIE CAMERA

Roll # Bolex II 005 school 203

Footage about 50-75 TOOK some footage

Figure 5

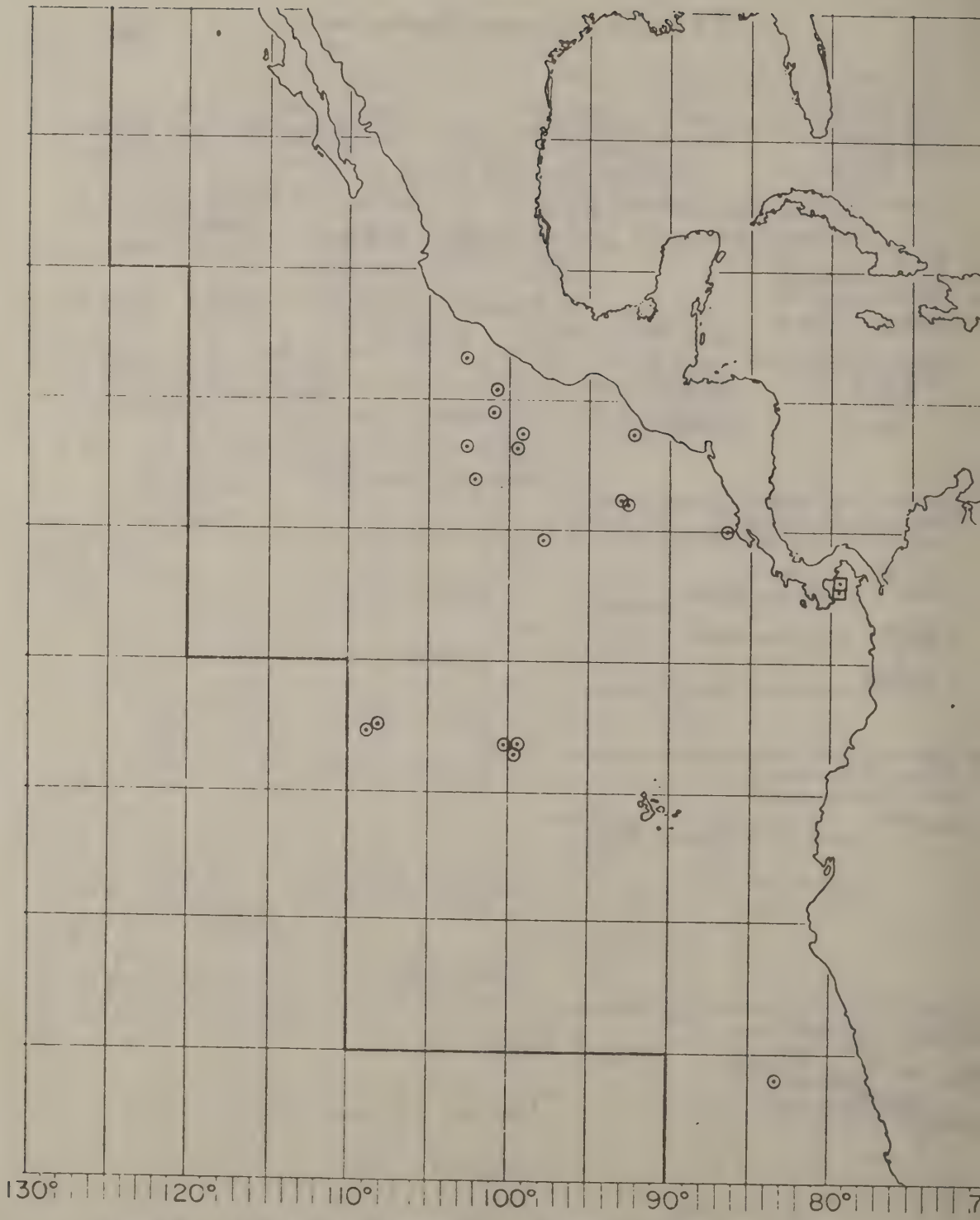

Figure 6. 1977 Aerial Sightings: ⊙ offshore spotted dolphin (Stenella attenuata)

⊡ coastal spotted dolphin (S. A. graffmani)

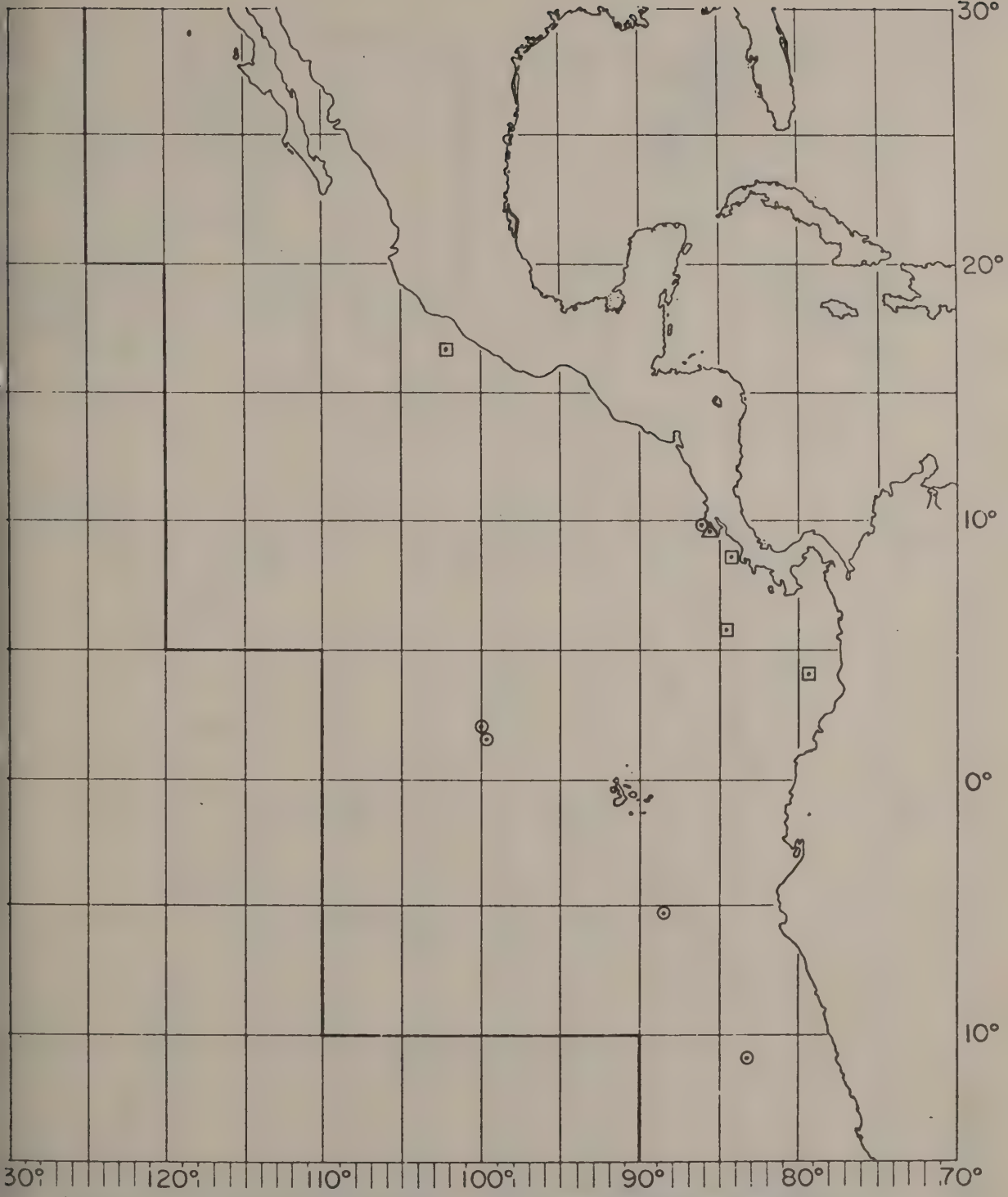

Figure 7. 1977 Aerial Sightings: ⊙spinner dolphin unidentified to subspecies (Stenella longirostris)

△Costa Rican spinner dolphin (S. I. Sub sp. A.)

⊡Eastern spinner dolphin (S. I. Sub sp. B.)

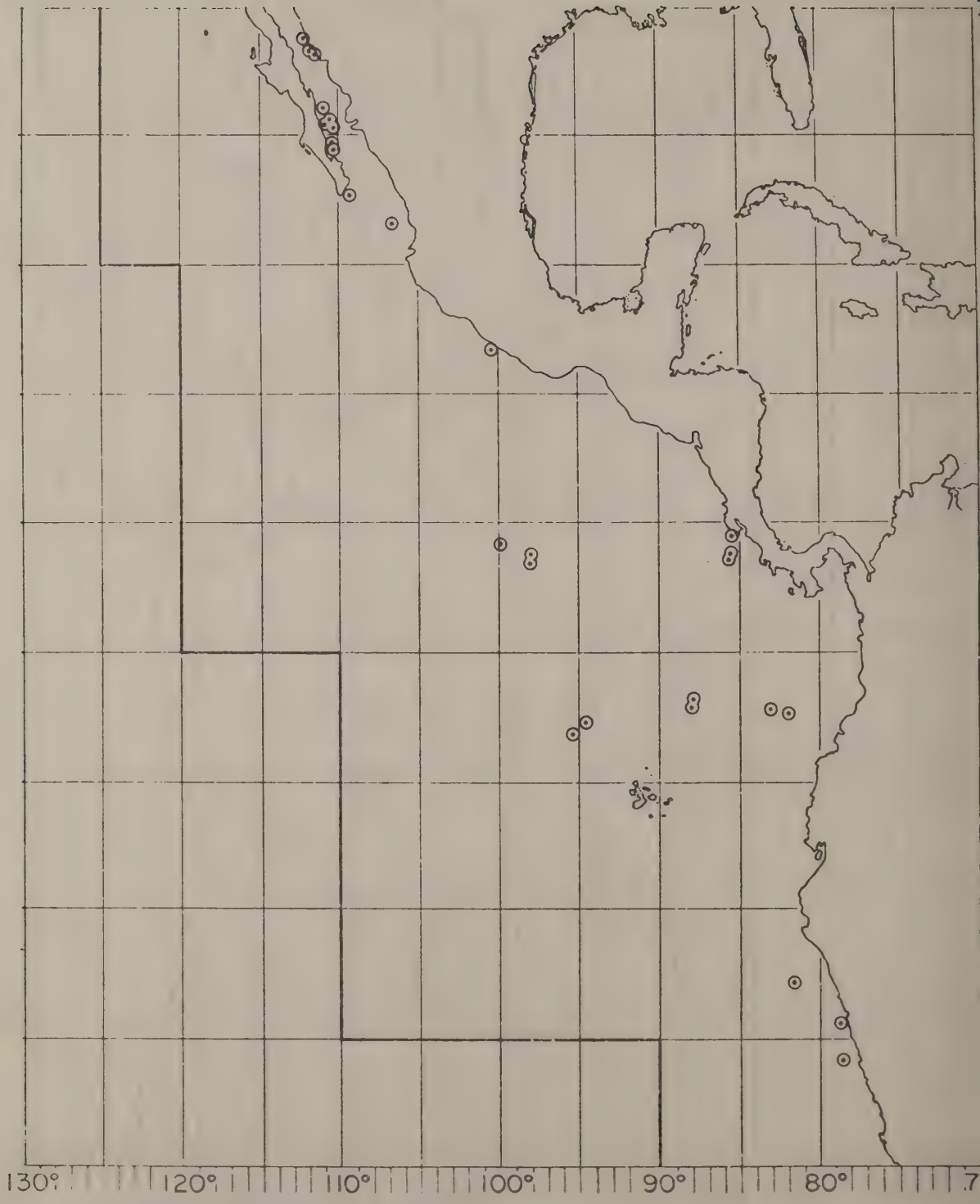

Figure 8. 1977 Aerial Sightings: ⊙common dolphin (Delphinus delphis)

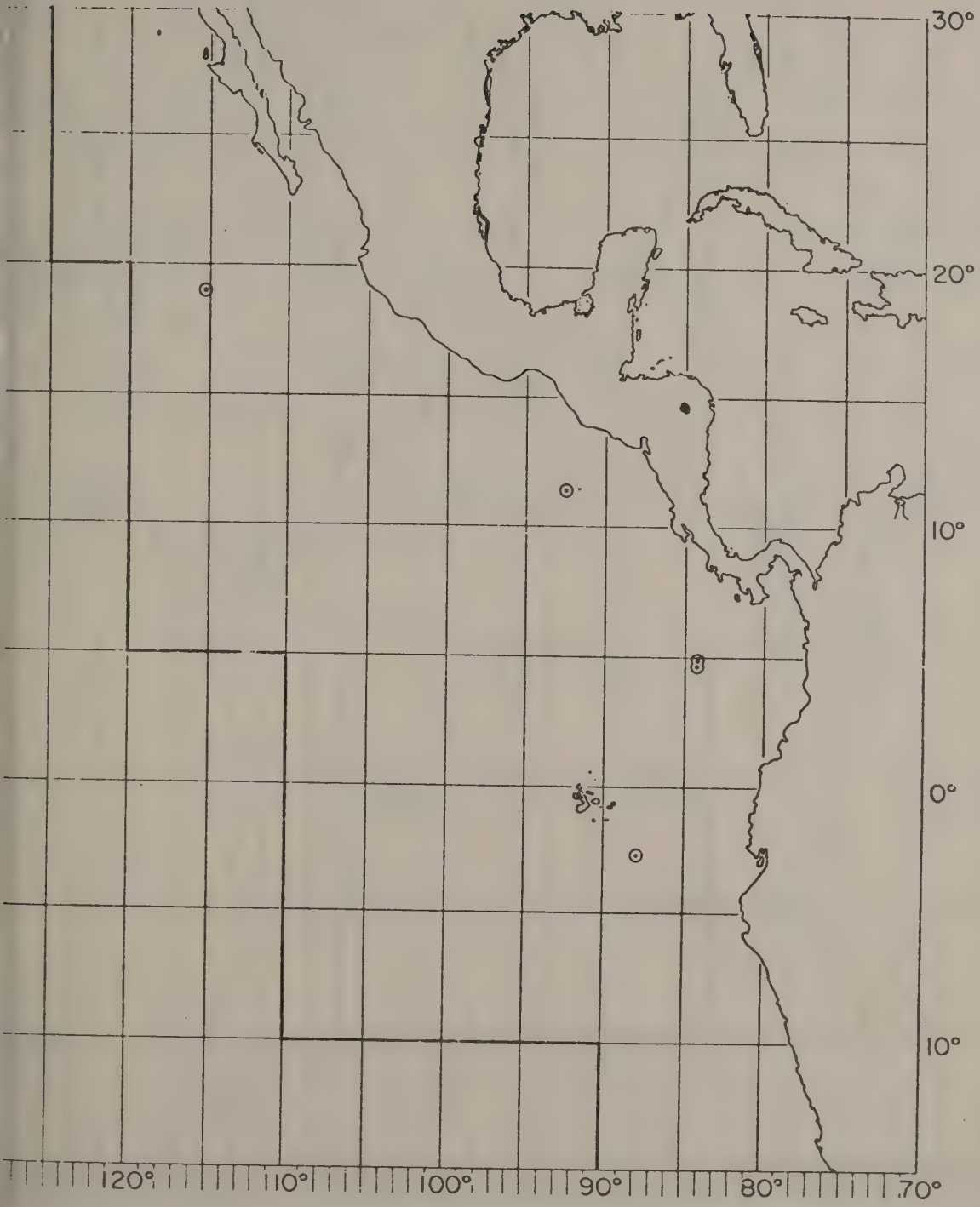

Figure 9. 1977 Aerial Sightings: ⊙striped dolphin (Stenella coeruleoalba)

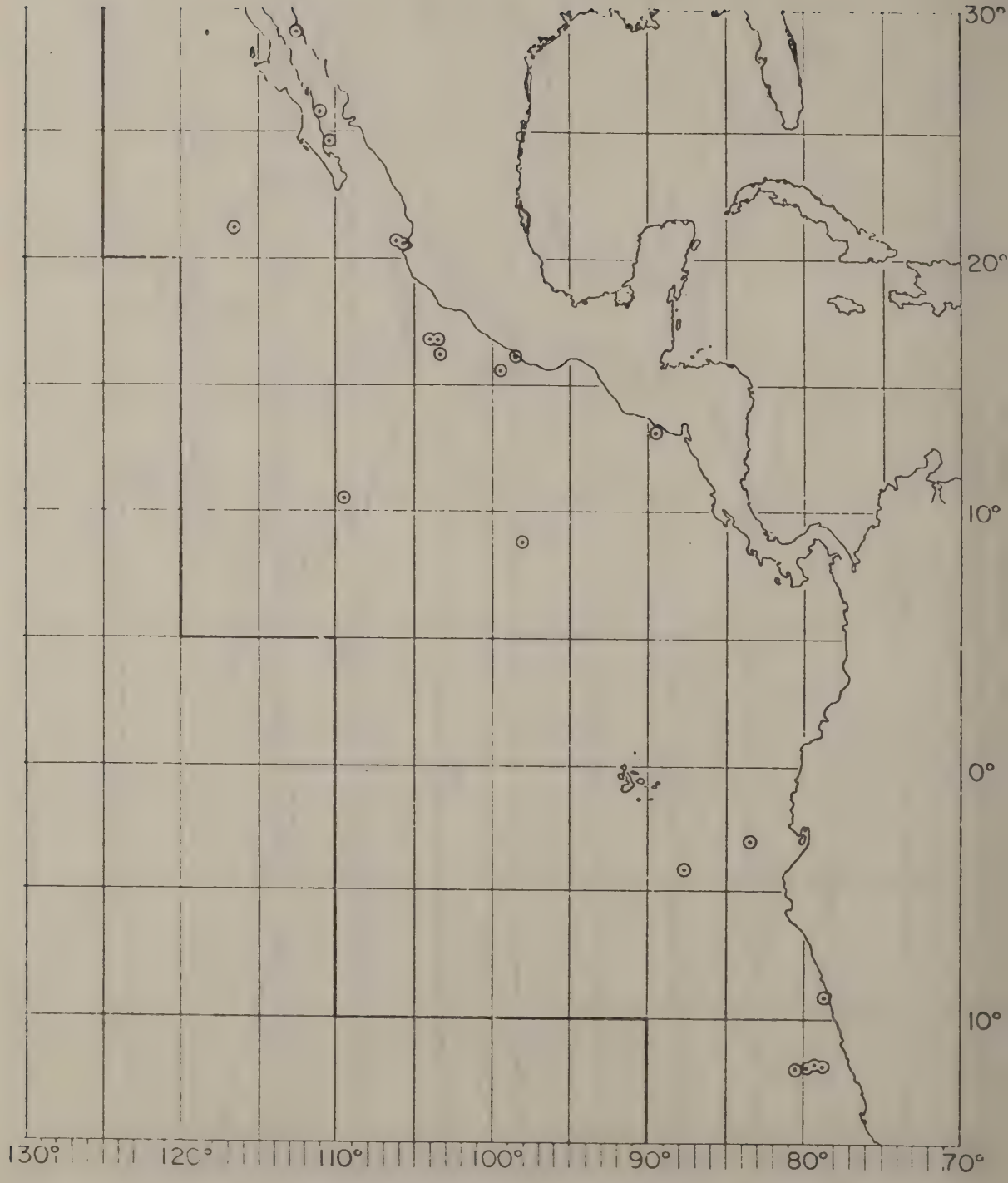

Figure 10. 1977 Aerial Sightings: ⊙bottlenosed dolphin (Tursiops truncatus)

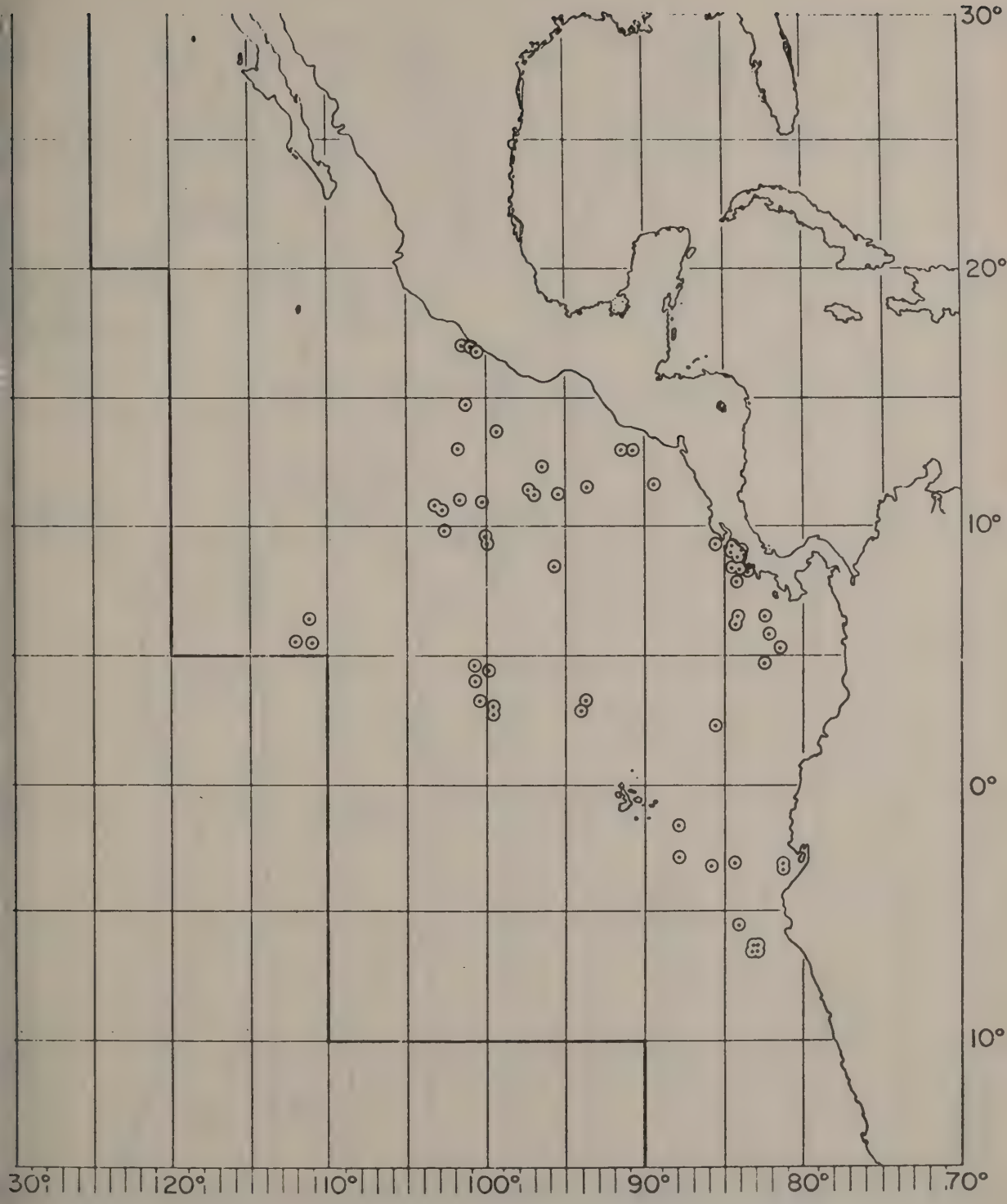

Figure 11. 1977 Aerial Sightings: ⊙Risso's dolphin (Grampus griseus)

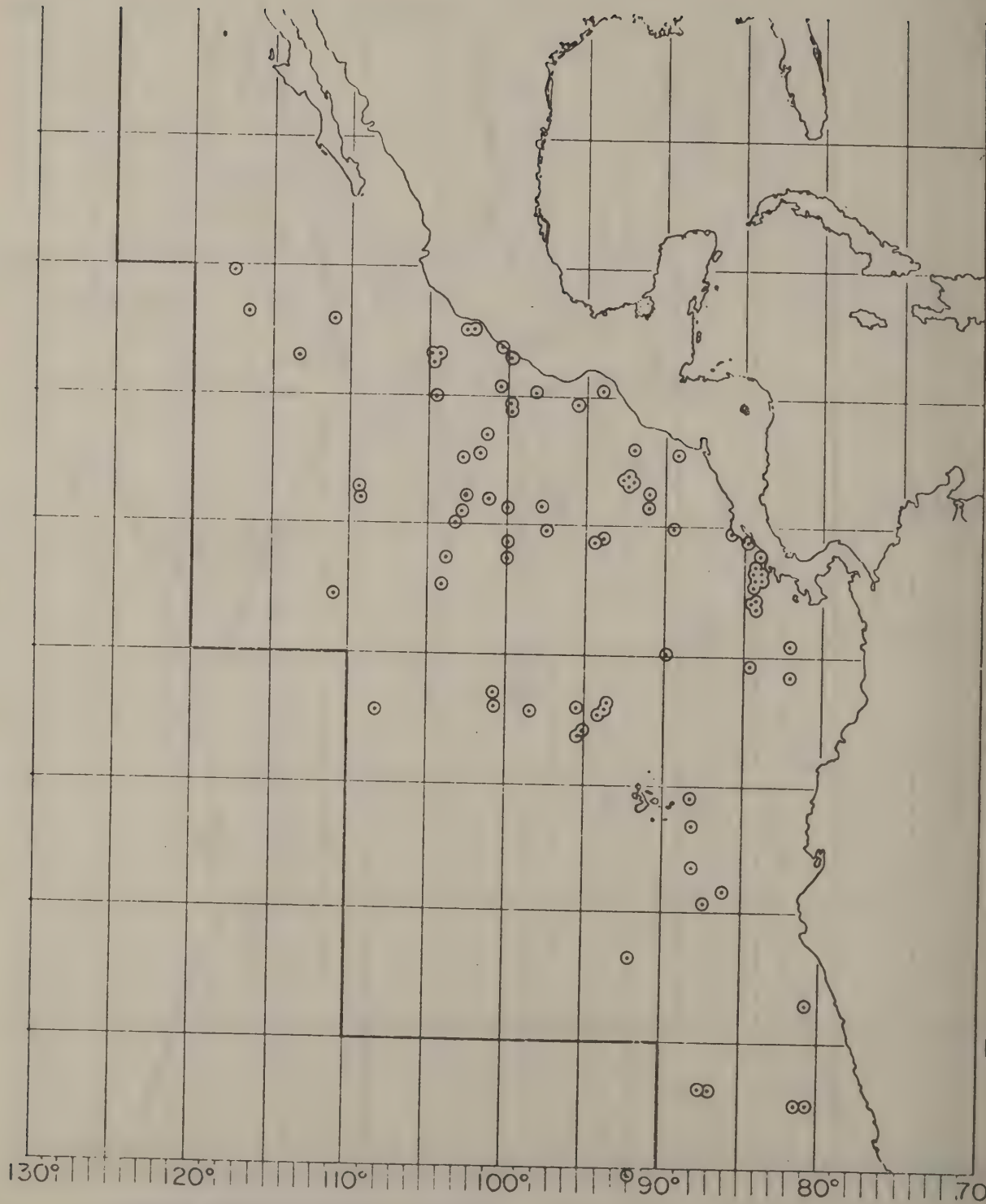

Figure 12. 1977 Aerial Sightings: ⊙ unidentified dolphins

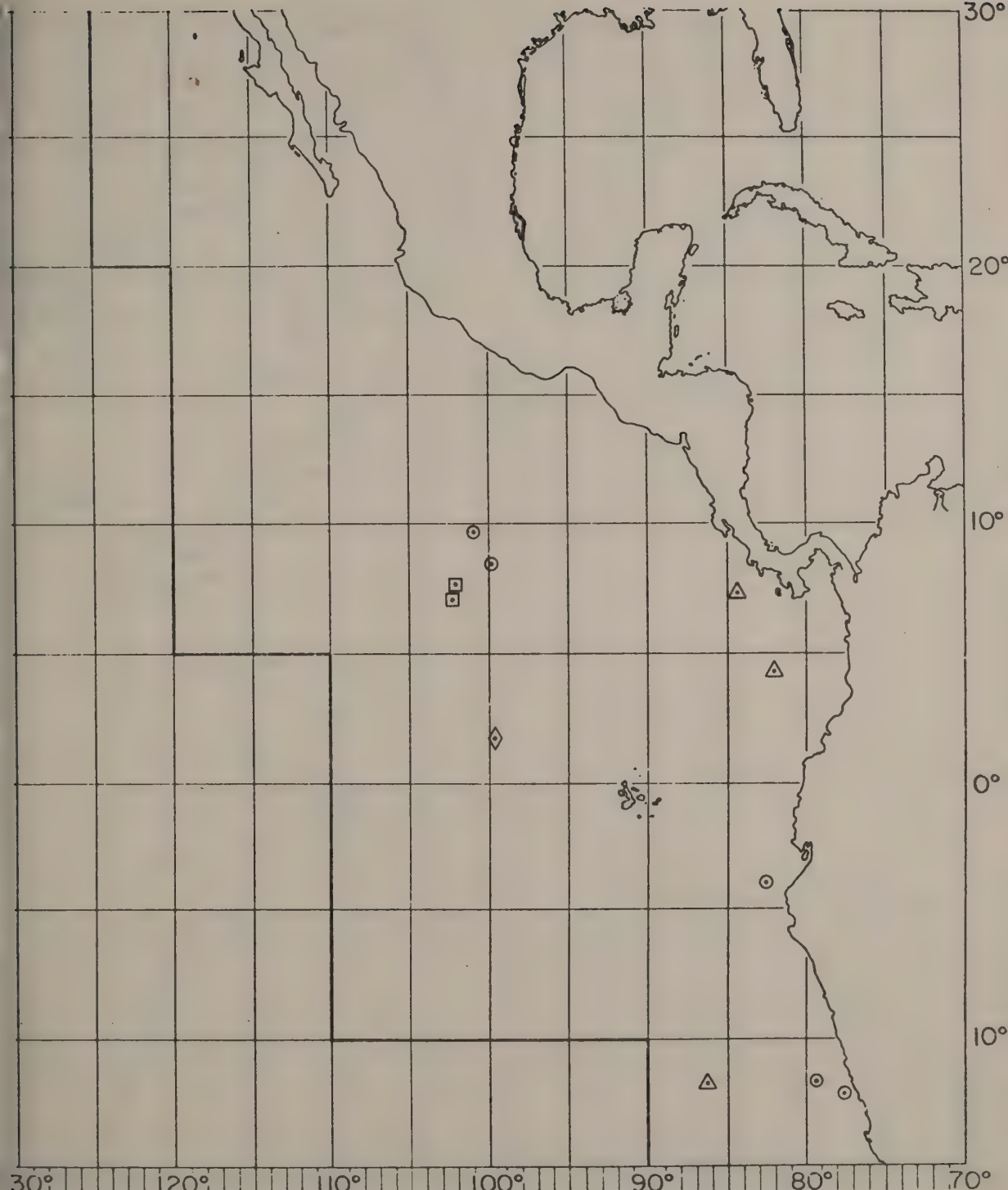

Figure 13. 1977 Aerial Sightings: ⊙ pilot whale (Globicephala spp.)
⊡ false killer whale (Pseudorca crassidens)
◊ killer whale (Orcinus orca)
△ beaked whale (Ziphiidae)

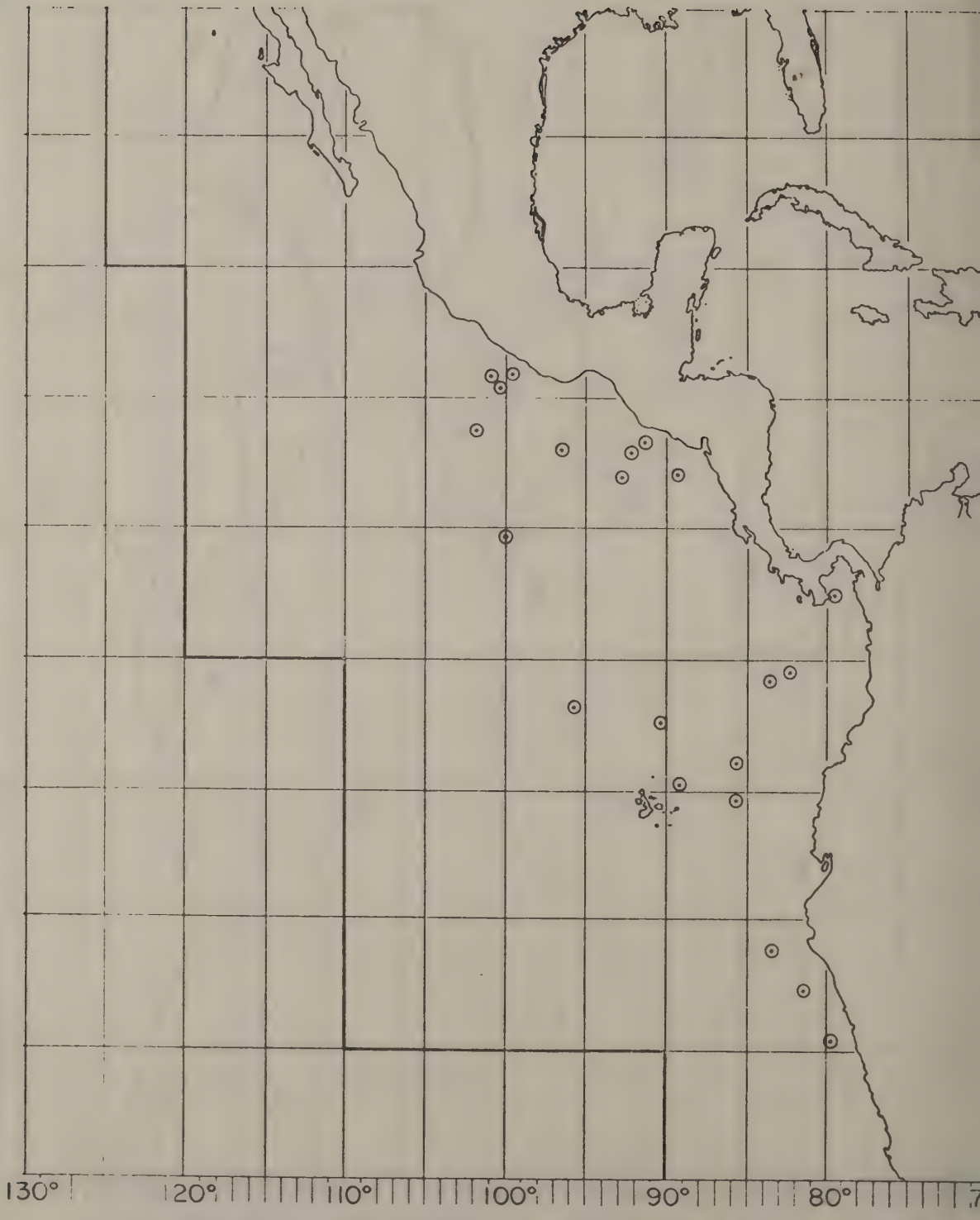

Figure 14. 1977 Aerial Sightings: ⊙sperm whale (Physeter catodon)

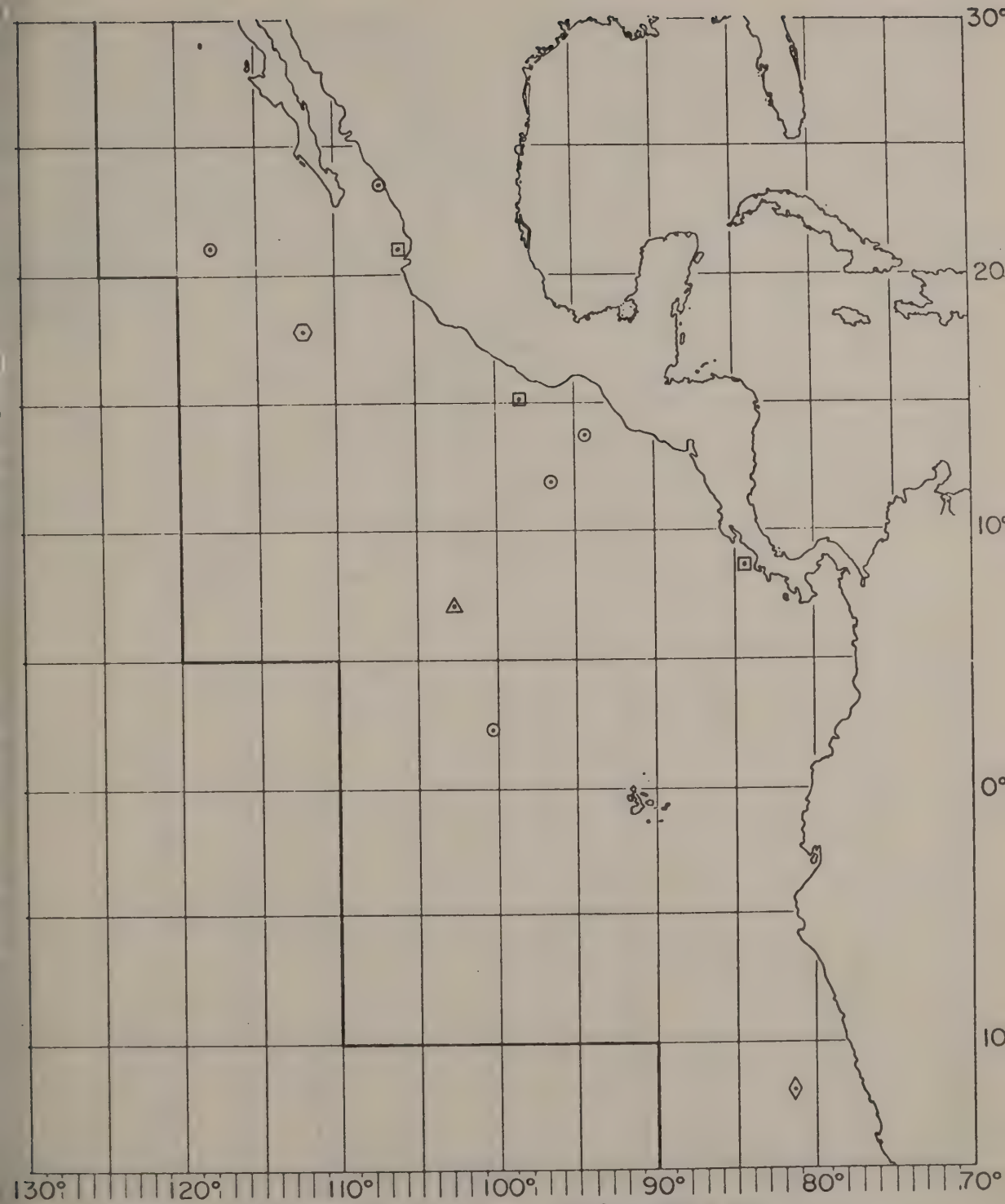

Figure 15. 1977 Aerial Sightings:

⊙ Baloenoptera spp.
◇ Minke whale (B. acutorostrata)
⊙ Bryde's whale (B. edeni)
△ blue whale (B. musculus)
⊡ humpback whale (Megaptera novaeangline)

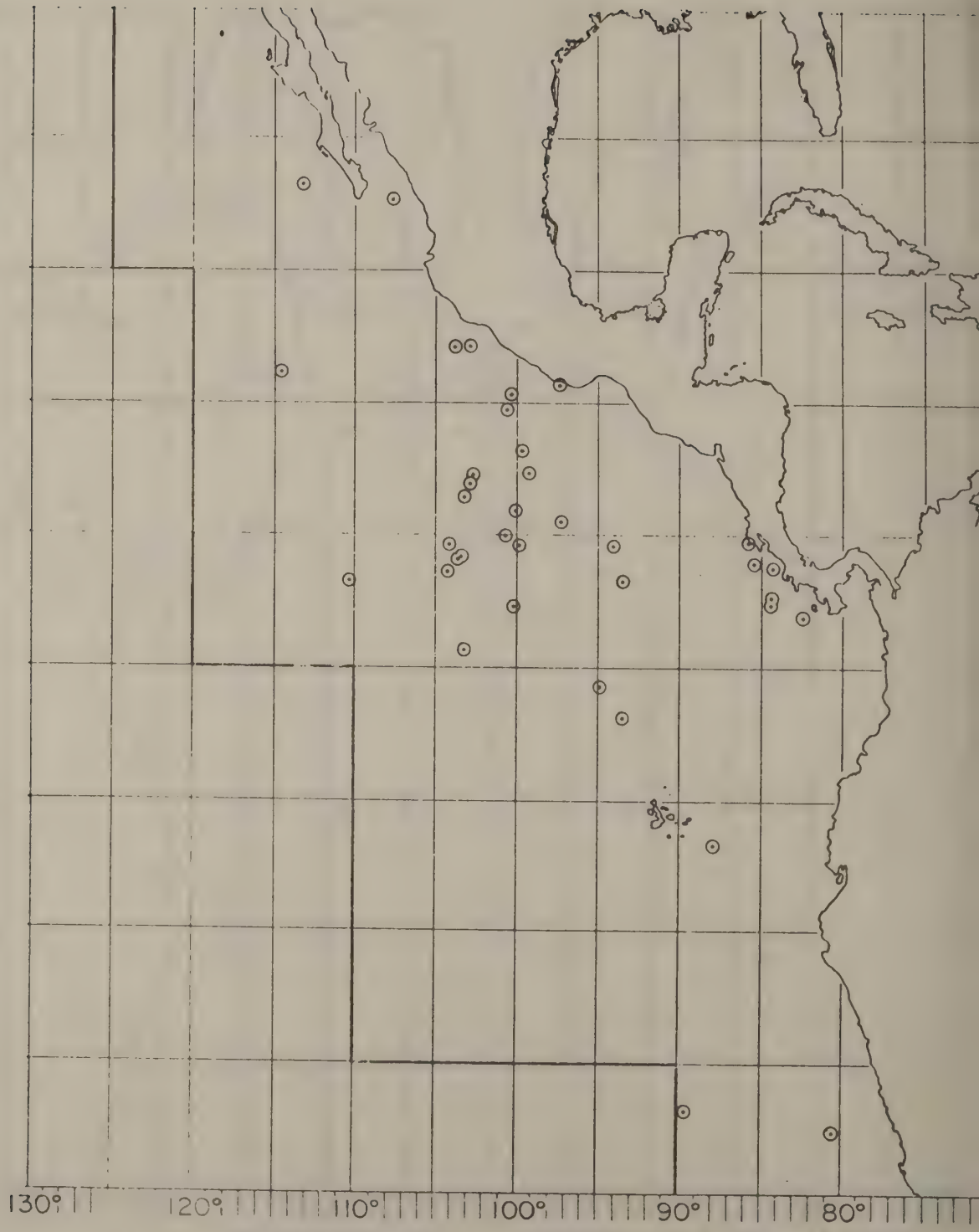

Figure 16. 1977 Aerial Sightings: ⊙unidentified small whales

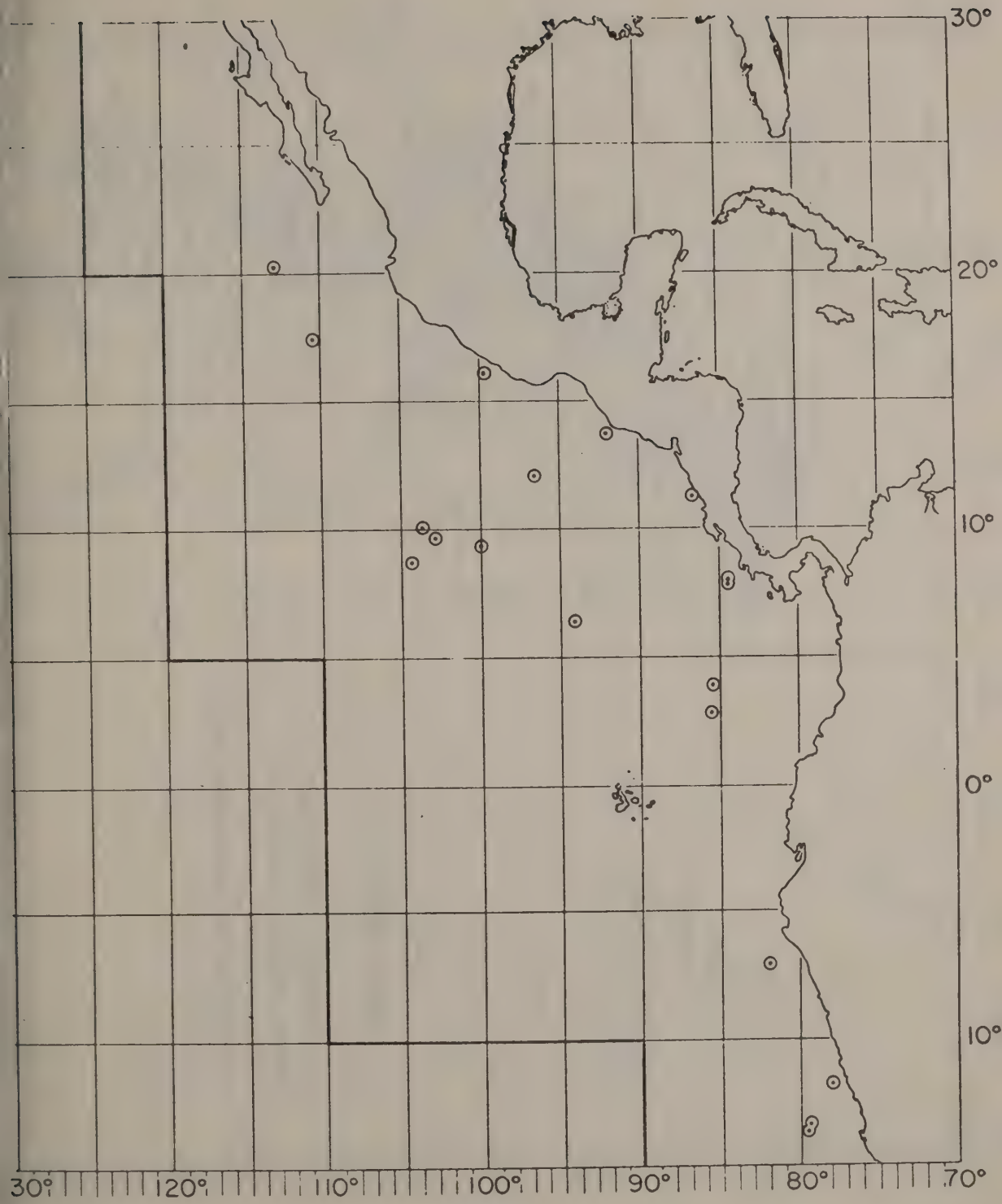

Figure 17. 1977 Aerial Sightings: ⊙unidentified large whales

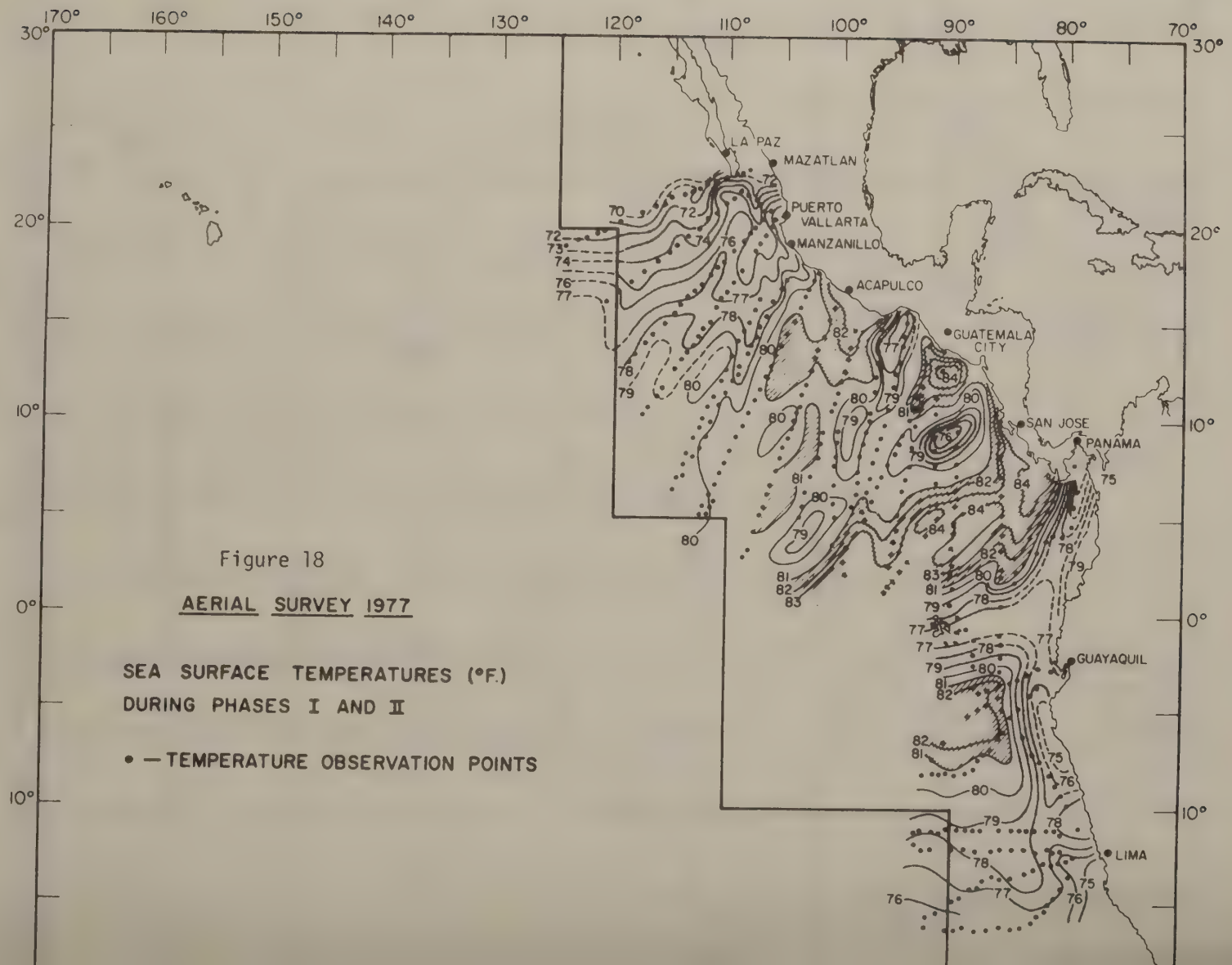

Figure 18

AERIAL SURVEY 1977

SEA SURFACE TEMPERATURES (°F.)
DURING PHASES I AND II

• — TEMPERATURE OBSERVATION POINTS

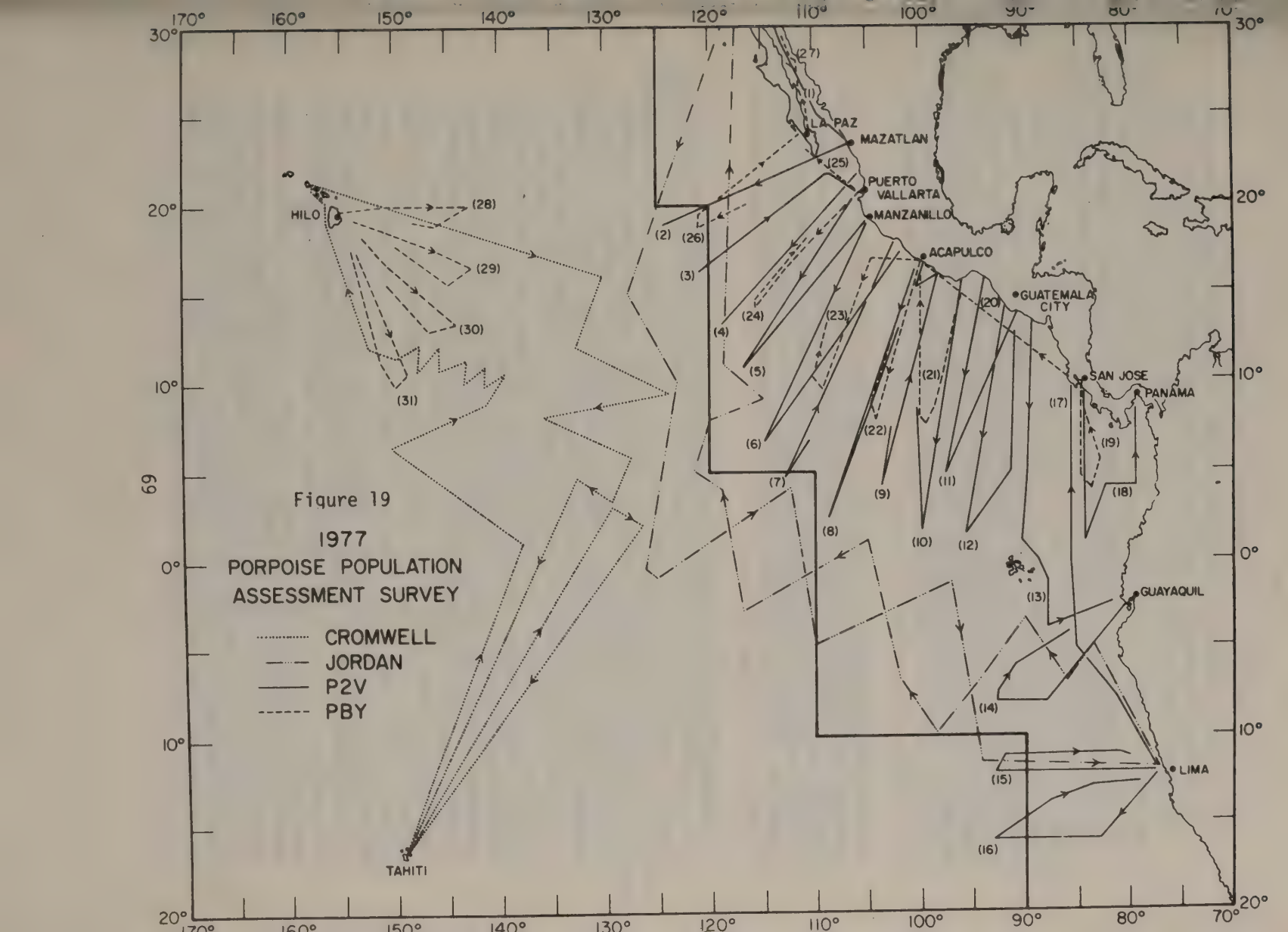
Figure 19
1977
PORPOISE POPULATION
ASSESSMENT SURVEY
CROMWELL
JORDAN
P2V
PBY
HILO
TAHITI
LA PAZ
MAZATLAN
PUERTO VALLARTA
MANZANILLO
ACAPULCO
GUATEMALA CITY
SAN JOSE
PANAMA
GUAYAQUIL
LIMA
(1)
(2)
(3)
(4)
(5)
(6)
(7)
(8)
(9)
(10)
(11)
(12)
(13)
(14)
(15)
(16)
(17)
(18)
(19)
(20)
(21)
(22)
(23)
(24)
(25)
(26)
(27)
(28)
(29)
(30)
(31)
170°
160°
150°
140°
130°
120°
110°
100°
90°
80°
70°
30°
20°
10°
0°
69

Departure of the P2V was postponed for 5 days (January 17 to 22) mainly due to a ruptured oil tank and malfunction of the propeller sync-control system. A mechanic from OAS Anchorage, Alaska, traveled to San Diego to aid in preparing the plane.

During a checkout after Flight 4 a fuel pump developed a leak. Thus Flight 5 was delayed for 3 days in Puerto Vallarta, Mexico while waiting for shipment of a replacement fuel pump (January 28 to 31). The first pump sent was air mail parcel post from Alaska. The pump that was finally installed on the plane was sent by special handling via Western and Mexicana airlines. The part was hand carried between the airlines in Los Angeles International Airport.

Flight 11 was delayed one day because the ferry flight from Acapulco arrived too late in Guatemala City to refuel (gasing facilities were closed) for early morning takeoff necessary to return to that air field before darkness. (Guatemala City Airport is surrounded by high volcanic mountains that make daylight operations recommended procedure for pilots unfamiliar with the terrain.)

Following Flight 11, the plane was considered unsafe by two members of the crew to continue operational flights due to small concavities and hairline cracks in the plexiglass propeller blades. The scientific party returned to San Diego via commercial jet on February 15. The P2V was ferried to San Diego and on to Burbank on the 16th and 17th of February. There, a set of spare blades shipped from Alaska were hung. However, inspection of the starboard engine, which had been using an inordinate amount of oil and spasmodically producing copious amounts of smoke, indicated major problems. The P2V was ferried to Phoenix, Arizona, and the faulty engine traded for one from another surplus plane. After further minor difficulties, the P2V arrived back in San Diego on March 19 with the scientific party aboard for the ferry flight back to Guatemala City. The first working flight of Phase II was made on March 22. Thus, the time delay between the end of Phase I and the beginning of Phase II was 36 days.

The first attempt at Flight 14, March 26, with two Ecuadorian Air Force officers aboard, was aborted when the warning light indicating metal in the engine oil of the port engine came on shortly after takeoff. The prop was feathered and we returned to Guayaquil on the starboard engine and the jets. Inspection for metal on the oil sump magnets was negative and a short in the electrical system was suspected. On the following day, Flight 14 was delayed for several hours as the sump light again came on while taxiing for takeoff. The suspected short was located and Flight 14, shortened by several hours, was successfully made.

Since departing on Phase II, the P2V had been performing very well--our only problem having been the faulty sump light--and we arrived in San Jose, Costa Rica, at the completion of Flight 17 from Lima, Peru only one day behind schedule.

On the April 4 flight from San Jose, Costa Rica (Flight 18), the port engine suddenly seized up and had to be quickly shut down and the prop feathered. We were circling around a school of porpoise at an altitude of 300-400 feet in the Gulf of Panama at the time only about 80 miles from Panama. Permission for an emergency landing was requested and granted by Howard Air Force Base, Canal Zone, Panama, and rather than chance making it back to San Jose where it would be necessary to fly over mountains at an altitude of 5,000 feet, we proceeded directly to Howard. On landing, preliminary tests showed that there was a heavy metal load in the oil, symptomatic of a ruined engine.

The following day, three members of the party returned to Costa Rica to rescue personal belongings, passports, turn in a rented car, and clear our departure with Costa Rican officials. The other members of the party were engaged in stripping equipment and gear out of the P2V. With the aid of base personnel, this material was crated for shipment to the United States.

On April 7, the entire party traveled via commercial airlines to Los Angeles, California, and on from there to various destinations.

The cost of transporting and installing a new engine for the P2V to Panama was prohibitive and the Office of Aircraft Services requested and received permission to turn the plane over to the Air Force for final disposition. The last information received is that the plane will be used for gunnery practice, which seems like a fitting end to a hard-luck aircraft.

With the aid of the Office of Aircraft Services, a contract for use of the Cousteau Society PBY was quickly negotiated. This plane had been at a Cooperative Costa Rican rework facility (Coopesa) for corrosion repair and fuselage modifications and had not been flown for about 6 months.

One member of the Cousteau group traveled to San Jose on April 18 and began to check out the plane for the flights. The rest of the crew and the scientific party met in Los Angeles and flew to San Jose on April 21. The next week was spent in working out problems with the avionics and engine carburation and making test flights.

The first flight had been scheduled for April 25, but because of these problems and the necessity of renewing our research permit with Mexico, the flight was not made until April 28, and then rather than flying to Acapulco, we repeated the last flight of the P2V. Thus a 24 day delay occurred between Phases II and III. Because of the altitude of San Jose, the plane could not take off with a full load of gas and it was necessary to cut the corners on this flight.

On April 30, a working ferry flight was made to Acapulco on a beeline course across the Gulf of Tehunantepec. After a day of upkeep, we took off with a full load of gas for Flight 21 (a repeat of Flight 10) early on the morning of May 2. The starboard landing gear failed to come up and the port engine was running hot so that we could not get altitude. Since we would have been unable to land safely on the water in an emergency situation, the up gear was forced down by hand, we dumped some gas, and returned to Acapulco.

A broken hydraulic line was replaced in a few hours but the next day and a half were spent futilely working on the oil cooling system attempting to solve the overheating problem. A decision was made to return to Coopesa for corrective repairs. Anticipating a quick fix, the head of the party went with the PBY unit while the rest of the scientific party remained in Acapulco.

The PBY arrived back in San Jose early on the morning of May 4, and after two unproductive days of exchanging all components that might affect engine and oil temperature with no improvement in performance, it was decided to change to a rebuilt engine that the Cousteau Society had stored at Coopesa. The engine replacement took two days and another two days were needed to test fly the plane and work out minor problems.

On May 9, the PBY ferried back to Acapulco and working flights were resumed the next day. The operation continued on without incident and the eight flights, some over 16 hours in duration, were completed in 10 days.

On May 18, at the end of a successful flight up through the Gulf of California to study the variability of observer porpoise estimates, the PBY continued on to Lindberg Field, San Diego. At touchdown, the nose wheel collapsed and the plane skidded along some 100 yards of runway on its nose digging a long furrow in the tarmack. Traffic was halted for some 30 minutes while a crane and tractor counterbalanced the plane so that the nose gear could be pulled back into place and we could taxi off the strip. This mishap was due to a loose screw which allowed the sequential locking mechanism to malfunction.

Between the end of Phase III and the beginning of Phase IV in Hawaii, a week's delay was anticipated to install auxiliary gas tanks, repair the relatively minor damage suffered in the Lindberg Field landing, and qualify a chief pilot in type. However, a series of minor complications with the engines and avionics delayed the start of the operation for an additional two weeks.

The PBY, stripped of all unnecessary gear and personnel, ferried to Honolulu on June 9 and the scientific party arrived in Hilo via commercial airline on the following day. The plane and scientific party got together the

next day and the 9-inch camera and other gear was installed in time to make the first of four working flights on the following day. Thus a 25 day delay occurred between Phases III and IV. These flights went off on schedule with a necessary 2-day pause between Flights III and IV for a 60-hour inspection being the only hold up.

The scientific party dispersed on June 20, the day after the last flight, and the PBY ferried back to Honolulu for installation of the ferry tanks. There, the PBY and crew waited for a break in the prevailing trade winds that blow from east to west at this time of year for an opportunity to ferry back to Los Angeles. In the next month, no change in the wind patterns developed, and it was decided to get the aircraft back by flying by way of Midway, Adak, and Alaska, about a 12-hour longer trip. These flights took place during the third week in July, the PBY finally arriving in Anchorage on July 22.